RAC2
EPA Region 2

Final Specifications

Old Roosevelt Field Contaminated Groundwater Area Superfund Site
Garden City, New York

EPA Contract No. EP-W-09-002
WA 008-RDRD-02PE

September 18, 2009

Final Specification
Old Roosevelt Field Contaminated Groundwater
Area Superfund Site
Garden City, New York
Work Assignment No.: 008-RDRD-02PE

Prepared for:
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EPA Work Assignment No.	: 008-RDRD-02PE
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Contract No.	: EP-W-09-002
CDM Federal Programs Corporation	
Document No.	: 3220-008-FDZ-FDDSZ-00169
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Date Prepared	: September 18, 2009

Old Roosevelt Field Superfund Site
Final Remedial Design

BIDDING SCHEDULE

Item	Description	Unit	Estimated Quanity	Unit Cost	Total
SECTION A - GENERAL REQUIREMENTS					
0001	General Conditions	L.S.	N/A	N/A	
0002	Safety, Health and Emergency Requirements	L.S.	N/A	N/A	
0003	Temporary Facilities and Utilities	L.S.	N/A	N/A	
0004	Erosion and Dust Control	L.S.	N/A	N/A	
0005	Surveying	L.S.	N/A	N/A	
0006	Decontamination	L.S.	N/A	N/A	
SECTION B - SITE WORK					
0007	Site Preparation	L.S.	N/A	N/A	
0008	Earthwork	L.S.	N/A	N/A	
0009	Yard piping	L.S.	N/A	N/A	
0010	Access Roads	L.S.	N/A	N/A	
0011	Fencing and Gates	L.S.	N/A	N/A	
0012	Storm Sewer Connection	L.S.	N/A	N/A	
0013	Site Restoration	L.S.	N/A	N/A	
SECTION C - WELL INSTALLATION					
0014	Test Borehole	L.F.	410		
0015	Extraction Well Installation	L.F.	1,020		
0016	Monitoring Well Installation	L.F.	1,680		
0017	Well Development	L.S.	N/A	N/A	
0018	Extraction Well Testing	L.S.	N/A	N/A	
0019	Extraction Well Pump Installation and Wellhead Completion	L.S.	N/A	N/A	

SECTION D - OFFSITE TRANSPORTATION/DISPOSAL

0020	Transportation and Disposal of Contaminated Material				
0020A	Soil Cuttings	TON	560		
0020B	Drilling Mud	Gal.	80,200		
0021	Transportation and Disposal of Uncontaminated Material	TON	20		

SECTION E - GROUNDWATER TREATMENT FACILITY

0022	Groundwater Treatment System	L.S.	N/A	N/A	
0023	Treatment Building	L.S.	N/A	N/A	
0024	System Startup Testing	L.S.	N/A	N/A	

SECTION F - SYSTEM OPERATION, MAINTENANCE AND MONITORING

0025	Groundwater Treatment System O&M	Month	12		
0026	Baseline and Site-Wide Groundwater Monitoring	L.S.	N/A	N/A	
0027	Recharge Basin Rehabilitation and Maintenance	L.S.	N/A	N/A	

SECTION G - OPTIONAL ITEMS (IRON REMOVAL TREATMENT SYSTEM)

0028	General Conditions	L.S.	N/A	N/A	
0029	Pilot Testing	L.S.	N/A	N/A	
0030	Treatment Building	L.S.	N/A	N/A	
0031	Iron Removal System and Testing	L.S.	N/A	N/A	
0032	Groundwater Treatment System O&M	Month	12		

TECHNICAL SPECIFICATIONS
OLD ROOSEVELT FIELD SUPERFUND SITE
FINAL SUBMITTAL
REMEDIAL DESIGN

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SECTION 01010

SUMMARY OF WORK

PART I GENERAL

1.1 SITE DESCRIPTION

The Old Roosevelt Field Superfund Site (Site) is an area of groundwater contamination within the Village of Garden City, in central Nassau County, New York. The site is located on the eastern side of Clinton Road, approximately 0.6 mile south of the intersection with Old Country Road. The Site includes a thin strip of open space along Clinton Road (known as Hazelhurst Park), a large retail shopping mall with a number of restaurants, and a movie theater. Several office buildings (including Garden City Plaza) share parking space with the shopping mall.

Two municipal water supply well fields are located south (downgradient) of the Site. The Village of Garden City public supply wells (designated as GWP-10 and GWP-11) are located just south of the site boundary, on the eastern side of Clinton Road. The Hempstead well field is located approximately 1.5 miles south of the Garden City supply wells. Two stormwater recharge basins are directly east and south of the mall area. The eastern basin, Pembrook, is located on property owned by the mall. The basin to the south is Nassau County Recharge Basin number 124.

Groundwater at the Site is contaminated with volatile organic compounds (VOCs), particularly chlorinated VOCs such as tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), dichlorodifluoromethane and 1,2-dichloroethane (1,2-DCA), and non-chlorinated VOCs such as methyl tert-butyl ether (MTBE). The remedy, as defined in the September 2007 Record of Decision (ROD), involves groundwater extraction and ex-situ treatment (pump and treat) in order to expedite the restoration of water quality in the aquifer in comparison with natural processes alone, and provide for vapor intrusion mitigation, if deemed necessary.

The scope of this package consists of the design, construction and operation of a groundwater extraction and treatment system at the Site to achieve the goals of the Record of Decision (ROD), as shown on the Contract Drawings and specified herein.

1.2 SITE HISTORY

The Site was used for aviation activities from 1911 to 1951. The United States (U.S.) military began using the Hempstead Plains field prior to World War I to train Army and Navy officers and as a training center for military pilots. In 1918, the Army changed the name of the airfield to Roosevelt Field.

After World War I, the U.S. Air Service authorized aviation-related companies to operate from Roosevelt Field, but maintained control until July 1, 1920, at which time the Government sold its buildings and relinquished control of the field. Subsequently, the property owners sold portions along the southern edge of the field and split the remainder of the property into two flying fields. The eastern half continued as Roosevelt Field, and the western half became known as Curtiss Field. Both fields were bought in 1929 by Roosevelt Field, Inc., and the property was once again called Roosevelt Field.

During World War II, Roosevelt Field was again used by both the Army and Navy. The Army used the field to provide airplane and engine mechanics training to Army personnel. As of March 1942, there were 6 steel/concrete hangars, 14 wooden hangars, and several other buildings at Roosevelt Field, which were used to receive, refuel, crate, and ship Army aircraft. In November 1942, the Navy Bureau of Aeronautics established a modification center at Roosevelt Field to install British equipment into U.S. aircraft for the British Royal Navy. The Navy was responsible for aircraft repair and maintenance, equipment installation, preparation and flight delivery of lend-lease aircraft, and metal work required for the installation of British modifications. The facility also performed salvage work of crashed Royal Navy planes. The Navy vacated all but six hangars shortly after the war ended. In August 1946, Roosevelt Field again operated as a commercial airport until it closed in May 1951.

Chlorinated solvents such as PCE and TCE have been widely used for aircraft manufacturing, maintenance, and repair operations since the late 1930s. Several military instruction manuals for aircraft maintenance and repair were issued during this time period which was specifically related to the use of solvents such as TCE for cleaning airplane parts and for de-icing. The types of airplanes designated for solvent use were reportedly present at the Site during World War II. As such, use of chlorinated solvents at the Site was very likely to have occurred.

Soon after the airfield closed, industrial plants for precision electronic instruments were under construction at Roosevelt Field and further development was planned. The large Roosevelt Field Shopping Center was constructed at the site and opened in 1957. Three of the old Navy hangars remained standing until sometime after June 1971, with various occupants, including a moving/storage firm, discotheque, amusement center, and bus garage.

Garden City installed two public supply wells, GWP-10 and GWP-11 in 1952, at what had been the southwest corner of the airfield. These two wells were put into service in 1953. Over the subsequent years, several other supply wells and cooling water wells were installed and operated at the former Roosevelt Field. In the late 1970s and early 1980s, investigations conducted by Nassau County found contaminants TCE and PCE in supply wells GWP-10 and GWP-11. High levels of contamination also were found in cooling water wells at the Site. The Site was listed on the National Priority List (NPL) on May 11, 2000.

From June 2005 to December 2006, CDM, the Remedial Action Contractor for EPA, performed a comprehensive remedial investigation (RI) at the Site (CDM 2007) to investigate the extent of groundwater contamination and to characterize the site geologic and hydrogeologic settings. During the RI, a total of 8 multiport monitoring wells were installed and two rounds of groundwater samples were collected. Monitoring well locations are shown on the Contract Drawing.

Following the RI, a feasibility study (FS) was completed to evaluate the remediation alternatives to treat the contaminant plume. Based on the findings in the RI and the recommendations in the Final FS, a ROD was signed in September 2007, selecting groundwater extraction and ex-situ treatment technologies to address the Site groundwater contamination.

A pre-design investigation was conducted by CDM from May to October 2008 to collect additional information required for the Remedial Design (RD). The major elements of the pre-design investigation included installation of three multiport monitoring wells (SVP-9, SVP-10, and SVP-11), one round of sampling of all existing wells and infiltration tests at the Nassau County recharge basin #124. In addition, CDM installed two additional multiport monitoring wells south of SVP-11 in July 2009, because of elevated TCE concentration detected in SVP-11. Monitoring well locations are shown on the Contract Drawing.

1.3 SITE GEOLOGY AND HYDROGEOLOGY

The following section summarizes the site-specific geology and hydrogeology in order to provide a framework for the remedial design at the Site. Complete discussion of the regional and site-specific geology and hydrogeology are presented in the RI Report (CDM 2007a).

1.3.1 Geology

The Site is located within the Atlantic Coastal Plain Physiographic Province. The geology of Long Island is characterized by a southeastward-thickening wedge of unconsolidated sediments unconformably overlying a gently-dipping basement bedrock surface. The wedge ranges in thickness from zero feet beneath Long Island Sound to the north, on the submerged western margin of the Coastal Plain, to more than 2,000 feet under the southern shores of Long Island. In the vicinity of the Site the sedimentary units thicken from about 800 feet at the northern edge of the Town of Hempstead to approximately 1,500 feet thick beneath the barrier islands.

The geologic units at the Site consist of:

- Basement - Precambrian to Early Paleozoic igneous or metamorphic bedrock
- Raritan Formation - Cretaceous Lloyd Sand Member (sand and gravel) and the overlying Raritan Clay Member (clay and silt as a confining layer)
- Magothy Formation - Cretaceous fine to medium quartz sand, interbedded clayey sand with silt, clay, and gravel interbeds or lenses, Interbeded clay is more common toward the top of the formation.
- Pleistocene Deposits - only the Upper Glacial deposits are identified at the Site. The Upper Glacial deposits are composed mainly of stratified beds of fine to coarse-grained sand and gravel; thin beds of silt and clay are interbedded with coarse-grained material

The Upper Glacial deposits and the Magothy Formation are the geologic units of interest for the Site.

1.3.2 Hydrogeology

The Upper Glacial and Magothy aquifer is unconfined and forms a single aquifer unit, although with different properties. In the vicinity of the Site, the depth to water ranges from 20 to 50 feet bgs, the saturated thickness of the Upper Glacial aquifer ranges from 20 to 40 feet; the thickness of the Magothy aquifer is about 500 feet. They are the most productive and heavily utilized groundwater resource on Long Island. Average transmissivities are 240,000 gallon per day per foot (gpd/ft) for the Magothy aquifer and 200,000 gpd/ft in the Upper Glacial aquifer. Average hydraulic conductivities are 228 feet per day (ft/d) in the Upper Glacial and 56 in the Magothy (Krulikas 1987).

During the RI, the depth to the water table at the Site was measured between 27 and 37.6 feet bgs. The general horizontal hydraulic gradient is to the south. Based on RI Round 1 data for the shallow aquifer, the groundwater flow gradient is 0.00156 ft/ft. Given this flow gradient, an effective porosity of 0.15, and the hydraulic conductivity for the Magothy aquifer (approximately 56 ft/d), the average linear velocity is estimated to be 0.6 ft/d.

Water level elevation data from the multi-port wells installed during the RI were used to evaluate vertical hydraulic gradient within each well location. In all multi-port wells, the vertical groundwater flow is downward. The four multi-port wells in the mall area have similar vertical gradients, with the differences between water levels in the shallow and deep ports within each well ranging from 1.8 to 2.9 feet. Further to the south, the vertical gradients become larger: 3.2 feet in SVP-7, 8.2 feet in SVP-8, and 9.7 feet in SVP-6. The higher vertical gradients in SVP-8 and SVP-6 are most likely caused by groundwater extraction of Hempstead pumping wells, which are located approximately one block from the multi-port wells.

1.4 SUMMARY OF CONTAMINATION

1.4.1 Groundwater

A number of Site-related contaminants were identified during the RI, including PCE, TCE, cis-1,2-DCE, 1,1-dichloroethene (1,1-DCE), and carbon tetrachloride. However, cis-1,2-DCE, 1,1-DCE, and carbon tetrachloride were only detected at low levels. The groundwater screening criteria utilized during the RI were developed based on EPA's National Primary Drinking Water Maximum Contaminant Levels (MCLs), New York State Standards and Guidance Values for Class GA groundwater (Human Water Source), and New York State Department of Health (NYSDOH) drinking water standards. The selected screening criteria for the above-mentioned Site-related contaminants were all at 5 µg/L.

As no Site-related contaminant were detected in the Upper Glacial Aquifer exceeding the groundwater screening criteria, the discussion below refers to the contamination in the Magothy aquifer only.

VOCs were detected in the upgradient monitoring well SVP-1, but at concentrations lower than the screening criteria. At the Site, SVP-2 is the most upgradient (north) monitoring well installed and sampled during the RI. This well is located in the vicinity of the cooling water well N-8050, where the highest detected PCE and TCE concentrations occurred in 1984, during the USGS investigation. During the RI, TCE was detected in SVP-2 at concentrations exceeding the groundwater screening criteria (TCE concentrations ranged from 12 to 38 J µg/L), on the other hand, all detected PCE concentrations for SVP-2 were below the groundwater screening criteria.

The highest levels of PCE and TCE (350 and 280 µg/L, respectively) were detected in SVP-4, at elevations ranging from approximately -221 to -156 feet below msl (approximately 250 to 310 feet bgs). It should be noted that the SVP-4 location was selected for monitoring due to the presence of a distilling well/drain field which was operated during the 1980s to dispose of cooling water contaminated with the Site-related VOCs. The next highest levels of PCE and TCE occur downgradient (to the south) of SVP-4 in monitoring well GWX-10019, at a slightly shallower depth (223 to 228 feet bgs), and in the two Village of Garden City supply wells GWP-

10 and GWP-11, at depths of approximately 150 feet deeper than the highest contaminant zone in SVP-4. These four wells comprise the core of the PCE/TCE contaminant plume.

GWP-10 and GWP-11 each have a capacity to pump approximately one million gallons per day (mgd) of groundwater from the Magothy aquifer (with the wells pumping alternately), and as a result, have a direct influence on the localized groundwater flow and corresponding contaminant plume migration. Pumping has created a significant cone of depression and thus limited the downgradient migration of contamination. Groundwater flow and contaminant movement from the contaminant sources appear to be both downward (vertical) and to the south (horizontal) toward the supply well GWP-10. Limited contamination has been observed south (downgradient) of the supply wells.

Further downgradient of the supply well(s), the highest levels of PCE and TCE detected in the most downgradient multi-port well (SVP/GWM-8) occurred at notably shallower depths than those within the plume core in the mall area. This observation, along with a line of other evidence (i.e., the shallower depth of contamination at the downgradient wells in the residential area, the presence of other sources of VOC contamination in the area south of the Site but upgradient of SVP/GMW-8, and the fact that the Village of Garden City supply wells have limited the southward migration of contamination associated with the Site), indicates that the contamination identified in those downgradient wells were likely not Site-related.

The Village of Hempstead Water Supply Wellfield, approximately one block south (downgradient) of multi-port monitoring wells SVP/GWM-6 and SVP/GWM-8, has been contaminated with VOCs since the 1980s. Two of the wells in the Village of Hempstead Water Supply Wellfield exhibited TCE detections of 11.8 µg/L (well screened from 390-542 feet bgs) and 9.2 µg/L (well screened from 344-444 feet bgs) during one routine monitoring event during 2007. Apparently, the contaminant plume thereof is located at a depth much deeper than that was encountered at the Site. The source of this contamination is currently unknown as several potential sources are located in the vicinity of the Hempstead Wellfield.

Non-aqueous phase liquids (NAPLs) are not believed to exist at the Site and the contaminant concentrations in groundwater have significantly decreased from the 1984 levels, especially at SVP-2.

1.4.2 Soil Gas

TCE detections exceeded the screening criterion of 2.2 micrograms per cubic meter (µg/m³) in one sample near Garden City Plaza building 200. Three samples collected along Hazelhurst Park (adjacent to Clinton Road) also had TCE detections that exceeded the screening criterion. Numerous other VOCs were also detected at very low levels in the soil gas samples collected in the vicinity of the buildings and along Hazelhurst Park, however, none of these VOCs exceeded the screening criteria and most were associated with gasoline.

1.5 PROJECT OBJECTIVES

1.5.1 The remedial action objectives (RAOs) of this project as described in the September 2007 ROD are as follows:

- Prevent or minimize potential, current, and future human exposures including inhalation, ingestion, and dermal contact with VOC-contaminated groundwater that exceeds MCLs
- Minimize the potential for off-site migration of groundwater with VOC contaminant concentrations greater than MCLs
- Restore groundwater to beneficial use levels within a reasonable time frame, as specified in the National Contingency Plan (NCP)
- Mitigate, if necessary, Site-related vapor migrating into the commercial buildings

The remedial objective of this contract will focus on the groundwater remedy part (i.e., the first three remedial objectives of ROD presented above), and will be met by extracting and treating contaminated groundwater from three different zones of aquifer, as shown on the Contract Drawings. Extracted groundwater will be treated onsite and discharged to the Nassau County recharge basin #124 under New York State Department of Environmental Conservation (NYSDEC) State Pollution Discharge Elimination System (SPDES) permit equivalency. The effectiveness of the groundwater treatment system will be measured by evaluating hydraulic head and water quality influent and effluent data to ensure that the core of the TCE and PCE plume (>100 ppb) is targeted to be extracted, treated and the treatment system is performing in accordance with the applicable effluent water quality standards.

The need for implementing an appropriate vapor remedy (e.g., subslab ventilation systems) will be determined and addressed in the future and is not within the scope of this contract.

1.5.2 A groundwater treatment system will be installed in a treatment building constructed at the location shown on the Contract Drawing or as approved by the Engineer.

1.5.3 Changes in groundwater quality resulting from groundwater extraction will be closely monitored as part of the site-wide groundwater monitoring program to evaluate remedy effectiveness and to monitor the remedial progress over time. The cleanup goals for aquifer groundwater quality at the site are the NYSDEC MCLs. Remedial system operation and/or site-wide groundwater monitoring will continue until the cleanup goals are achieved.

1.5.4 This design consists of two types of specifications, performance and prescriptive designs. The groundwater extraction system, including all process, controls, building, mechanical, electrical, instrumentation, and HVAC is intended to be performance based. The prescriptive portion of the design includes the extraction well design and layout, civil work, and monitoring and analysis. The Contractor shall be required to submit a design to meet all performance based requirements for the Engineer's review and approval prior to submitting shop drawings for the construction of groundwater treatment system.

1.5.5 Performance-based design criteria and requirements were developed for the groundwater treatment system based on industry standards and technical considerations that are specific to the Site groundwater treatment system construction, start-up, and operation and maintenance (O&M).

1.5.6 Performance-based criteria shall include but not limited too:

- Extraction well installation and development method, selection of gravel pack, and determining the screen slot size

- Minimum treatment train requirements
- Minimum unit process design and sizing requirements
- Minimum process instrumentation and control requirements
- Minimum construction and/or operation standards for equipment and materials
- Minimum building construction requirements
- Construction quality assurance/quality control (QA/QC) testing requirements
- Startup testing requirements to demonstrate treatment system performance based on field data and measurements
- O&M sampling, monitoring, and reporting requirements

1.6 WORK INCLUDED IN DESIGN PACKAGE

The Contractor shall complete all work covered by the Contract Documents. This work includes base and option work as specified below and in the Contract Documents.

1.6.1 The base work primarily consists of, but is not limited to the following:

- Mobilization
- Obtaining permits unless otherwise noted
- Preparing shop drawings and obtaining approvals
- Site Preparation in accordance with Contract Documents
- Monitoring well installation
- Extraction well installation including step and yield testing, and sampling
- Baseline sampling
- Influent and effluent pipe installation
- Procurement and construction of treatment building
- Procurement and installation of process equipment, instrumentation and control, electrical, and mechanical (piping, valves, HVAC, etc.)
- Start up and performance testing
- Site Restoration
- Demobilization
- Operation and Maintenance (one year)
- Performance Monitoring (one year)
- Site-wide sampling (one year)

1.6.2 The option work primarily consists of but is not limited to the following:

- Pilot-testing for iron removal system
- Expanding the treatment process to include iron removal system and building to accommodate the iron removal system
- Additional O&M

The option work may be implemented after completion of Stage 1 task, when needed, as discussed below in Section 1.7.2.

1.7 WORK SEQUENCE

The work specified herein and presented in the Contract Documents shall be performed in a phased approach. The purpose of the phased approach is to effectively coordinate between the base work and the option work if required to be implemented. As discussed herein and shown on the Contract Drawings, the overall project scope is divided into five distinct stages, i.e., Pre-Stage I, and Stage I, II, III and IV. The listing of work items and work sequence presented herein, may not include all specific items. The construction sequence presented herein is provided as a planning mechanism to the Contractor. The Contractor shall implement the construction tasks presented; however, these tasks need not necessarily be completed in the order shown. Unless noted otherwise, the Contractor shall perform all items as part of the work of this contract.

1.7.1 Project Startup (Pre-Construction Activities) and Pre-Stage 1

Project startup and Pre-Stage 1 activities shall be completed prior to initiating remedial activities. Project startup and Pre-Stage 1 shall include but is not limited to the following:

1.7.1.1 Obtain all necessary permits and approvals, as specified herein or other specification sections for the implementation of Stage 1 activities.

1.7.1.2 Develop, submit, and gain approval for all pre-construction submittals, including Site Safety and Health Plan; Contractor Quality Control Plan; Initial Project Schedule; Environmental Protection Plan; Sampling and Analysis Plan; Temporary Site Facilities Layout Plan; Security Plan; Excavation, Trenching, Compaction and Grading Plan; Soil Erosion and Sediment Control Plan; and other plans required prior to the commencement of work. No work shall commence prior to approval.

1.7.1.3 Provide required entrance medical examinations for the workforce and proof of satisfactory safety and health training as specified in SECTION 01351 - SAFETY, HEALTH, AND EMERGENCY RESPONSE.

1.7.1.4 Retain the services of a licensed land surveyor registered in the State of New York to perform surveys during construction and submit the survey data to the Engineer.

1.7.1.5 Contact utility companies and property owners, and field verify utility locations.

1.7.1.6 Install soil erosion, sedimentation, and other environmental control measures as specified.

1.7.1.7 Construct necessary site access, temporary facilities, utility connections, staging areas, and parking.

1.7.1.8 Identify and characterize clean top soil source.

1.7.2 Stage 1 - Installation of Extraction and Monitoring Wells

1.7.2.1 Furnish all required shop drawings, calculation, data literature, schedules, reports, manuals, samples, and other submittals in accordance with SECTION 01330 - SUBMITTAL PROCEDURES, and the various technical sections to complete Stage 1 activities.

1.7.2.2 Sawcut asphalt pavement as needed for installation of wells and vaults.

1.7.2.3 Install and develop new extraction and monitoring wells in accordance with SECTION 02525 - WELL INSTALLATION AND TESTING.

1.7.2.4 Perform step drawdown and yield testing on extraction wells in accordance with SECTION 02525 - WELL INSTALLATION AND TESTING.

1.7.2.5 Discharge well development, step drawdown and yield testing water to local storm sewer via a temporary treatment system meeting the SPDES discharge requirements.

1.7.2.6 Analyze the step drawdown and yield testing data and submit for approval.

1.7.2.7 Complete extraction well sampling in accordance with SECTION 01450 - CHEMICAL DATA QUALITY CONTROL to determine whether iron removal component (optional item) will be needed to meet the SPDES discharge criteria.

1.7.2.8 Install groundwater pump and complete extraction well installation, including well vaults.

1.7.3 Stage II -Groundwater Treatment System Fabrication/Installation and Yard Piping

1.7.3.1 Perform the detailed design as per the requirements of these specifications and Contract Drawings. Furnish all required plans, shop drawings, calculation, data literature, schedules, reports, manuals, samples, and other submittals in accordance with SECTION 01330 - SUBMITTAL PROCEDURES, and the various technical sections to complete Stage 2 activities. No work shall commence prior to approval.

1.7.3.2 Obtain all necessary permits and approvals for fabrication/installation of groundwater treatment system and completion of yard piping, as specified herein or other specification sections.

1.7.3.3 Coordinate with Village of Garden City and Nassau County regarding specific types and locations of all required traffic control measures for use during the construction.

1.7.3.4 Install soil erosion, sedimentation and other environmental control measures in accordance with these Contract Documents, applicable regulations and the Contractor's approved Soil Erosion and Sediment Control Plan for completion of Stage II work.

1.7.3.5 Install barrier fencing, gates and signs to establish work zones and restrict access.

1.7.3.6 Erect the treatment building in accordance with SECTION 13122 - GROUNDWATER TREATMENT BUILDING.

1.7.3.7 Install groundwater treatment system in accordance with SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

1.7.3.8 Complete the baseline round of site-wide groundwater monitoring in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE.

1.7.3.9 Sawcut asphalt pavement, and clear and grub as needed for the installation of groundwater treatment system building, piping, instrumentation and electrical facilities.

1.7.3.10 Complete installation of yard piping, electric and control lines, and well head piping, in accordance with the Contract Documents. Backfill and compact all pipe trenching.

1.7.3.11 Complete trouble shooting, and process adjustments/modifications in accordance with SECTION 13300 - GROUNDWATER TREATMENT SYSTEM and SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE. Work shall be completed by qualified representative of groundwater treatment system design/integration vendor, if applicable, with assistance from the subcontractor.

1.7.3.12 Complete system startup testing as part of the initial testing program, in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATIONS AND MAINTENANCE and address Pre-Final Inspection punch-list items. Complete trouble-shooting and process adjustments/modifications and refine operational settings to optimize treatment system performance. Work shall be completed by qualified representatives of the groundwater treatment system design/integration with assistance from the subcontractor, until system operation is stable and the subcontractor personnel have received training on the operation and maintenance of each groundwater treatment system.

1.7.3.13 Perform a Pre-Final Inspection and operational demonstration of the groundwater treatment systems with EPA, Contractor, and Subcontractor representatives to demonstrate substantial completion of construction in accordance with SECTION 01451 - CONTRACTOR QUALITY CONTROL.

1.7.4 Stage III -Site Restoration and Demobilization shall include, but not necessary be limited to, the following:

1.7.4.1 Complete site restoration, including asphalt pavement, seeding, fencing, access road as shown on the Contract Drawings.

1.7.4.2 Remove site perimeter soil erosion and sedimentation control facilities.

1.7.4.3 Remove temporary site fencing as required.

1.7.4.4 Properly dispose of all waste generated during construction.

1.7.4.5 Prepare and submit a written report of ultimate disposition of all containers and wastes removed, including copies of all completed manifests.

1.7.4.6 Disconnect temporary utilities from the construction trailers and demobilize trailers.

1.7.4.7 Complete closeout and project documentation in accordance with SECTION 01720 - PROJECT RECORD DOCUMENTS.

1.7.4.8 Installation of fence around the treatment facility, installation of access road and gravel area as shown on the Contract Drawing.

1.7.5 Stage IV - Operational & Functional Period shall include, but not necessarily be limited to, the following:

1.7.5.1 Furnish all labor, materials, equipment, services, and incidentals necessary to operate and maintain the groundwater treatment systems, and perform performance and site-wide groundwater monitoring for a period of one year in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE and as otherwise required.

1.7.5.2 Perform routine groundwater treatment systems operation and monitoring and maintain groundwater treatment systems operation at greater than 90 percent uptime.

1.7.5.3 Perform routine, scheduled, unscheduled, and required maintenance of groundwater treatment systems, including process equipment and facilities.

1.7.5.4 Provide the laboratory services and equipment required for sampling, sample analysis, and field measurements.

1.7.5.5 Furnish all replacement supplies, and incidentals consumed as part of groundwater treatment systems operation.

1.7.5.6 Provide miscellaneous on-site support to the Engineer during operational and functional period as directed by the Engineer.

1.7.5.7 Properly handle, characterize, and dispose of all wastes generated as part of groundwater treatment systems operation, maintenance, and monitoring in accordance with regulatory requirements.

1.7.5.8 Pay all initial and periodic utility (i.e., electric, telephone, water) fees and maintenance charges required for groundwater treatment systems operation.

1.7.5.9 Obtain and pay for all licenses, permits, and insurance required for groundwater treatment systems operation.

1.8 OPTIONAL WORK INCLUDED IN DESIGN PACKAGE

The Contractor shall complete the listing of optional work items presented herein, if a need of installing additional iron removal components has been demonstrated based on the results of the sampling as described in Paragraph 1.7.2. The option work is described in Paragraph 1.6.2.

1.9 WORK NOT INCLUDED

Securing permanent easements and access agreements from property owners for the work shown on the Contract Drawings and contained herein prior to construction are not the responsibility of the Contractor. All access agreements necessary to access the properties for the installation of extraction and monitoring wells, interconnecting piping, and installation of groundwater treatment systems have been obtained by the Government.

New York State Pollution Discharge Elimination System (NYSPDES) permit for discharging of the treated water will be obtained by the Government.

1.10 CONTRACTOR'S USE OF PREMISES

The Contractor shall limit onsite operations to the work areas as shown on the Contract Drawings, unless authorized by the Engineer. Work in areas outside of construction limits shall be coordinated with the Engineer.

1.11 SITE ACCESS

Property access for the Site shall be coordinated by the Engineer. Hours of operation need to be established at the beginning of the project so that the Engineer can negotiate access. Deviations from the established schedule shall require notice at least 7 days in advance to the Engineer to notify the owner and receive approval.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01201

PRE-CONSTRUCTION AND PRE-WORK CONFERENCES

PART 1 GENERAL

1.1 PRE-CONSTRUCTION CONFERENCE

Within 30 calendar days after issuance of the Notice to Proceed (NTP), the Contractor shall meet with the Engineer for a Pre-Construction Conference to discuss project schedules.

1.2 PRE-WORK CONFERENCE

1.2.1 Approximately two weeks prior to the start of construction, a Pre-Work Conference will be held between the Contractor and Engineer. Attendance by the Contractor's superintendent, quality control personnel, safety personnel, and subcontractor's superintendents shall be required. The purpose of this conference is to review submittals, safety, payrolls and labor relations, environmental protection, project schedules and payment, and procurement of materials. Questions concerning the administrative requirements or any other aspect of the project may also be addressed.

1.2.2 Unless specified otherwise, the Contractor shall submit 6 copies of the following for review at least 21 calendar days prior to the Pre-Work Conference:

1.2.2.1 Initial Project Schedule, in accordance with SECTION 01320.

1.2.2.2 Site Safety and Health Plan, in accordance with SECTION 01351.

1.2.2.3 Environmental Protection Plan, in accordance with SECTION 01355.

1.2.2.4 Uniform Federal Policy Quality Assurance Project Plan, in accordance with SECTION 01450.

1.2.2.5 Contractor Quality Control Plan, in accordance with SECTION 01451.

1.2.2.6 Temporary Site Facility Layout Plan, in accordance with SECTION 01500.

1.2.2.7 Transportation Plan, in accordance with SECTION 02120.

1.2.2.8 Drilling Methods, in accordance with SECTION 02525.

1.2.2.9 Excavation, Trenching and Backfill Plan, in accordance with SECTION 02300.

1.2.2.10 Soil Erosion and Sediment Control Plan, in accordance with SECTION 02370.

1.2.2.11 Groundwater Treatment Plan, in accordance with SECTION 13300.

Any plans submitted to the Engineer in advance of the Pre-Work conference will be briefly reviewed by the Engineer and will also be subjected to discussion during this conference.

1.3 PRE-CONSTRUCTION QUALITY CONTROL CONFERENCE

1.3.1 After the Pre-Work Conference, before start of construction, a Pre-Construction Quality Control Conference will be held between the Contractor and Engineer. The purpose of this conference is to discuss the quality control procedures to be used for all onsite and offsite work, and defining the interrelationship of the Contractor's Management and the Engineer's Quality Assurance. Additional details are included in SECTION 01451.

1.4 PRE-CONSTRUCTION SAFETY CONFERENCE

The Contractor shall meet with the Engineer for a Pre-Construction Safety Conference, before start of construction. The purpose of this conference is to discuss how work will be implemented including, but not limited to, work procedures, safety considerations associated with those work procedures, heavy equipment to be used, training to operate equipment, and safety requirements, such as training and safety equipment.

1.5 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.5.1 Conference Meeting Minutes; Product Data, EA

The Contractor shall record the minutes of the meetings including significant proceedings and decisions arising from the four conferences, and within seven calendar days after each meeting furnish 3 copies of the minutes to the Engineer. After the Engineer's review and approval, the Contractor shall distribute copies to each participant in the meeting and to parties affected by decisions made at the meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

The Engineer shall schedule and administer the Pre-Construction Conference, Pre-Work Conference, Pre-Construction Quality Control Conference and Pre-Construction Safety Conference, as specified in Paragraphs 1.1 through 1.4 of this section. The Engineer shall prepare agenda and preside at conferences. The Contractor shall make physical arrangements for and participate at conferences; and shall record the minutes including a detailed description of proceedings and decisions, as specified in Paragraph 1.5.1 of this section.

END OF SECTION

SECTION 01202

PROJECT PROGRESS MEETINGS

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This section describes the minimum requirements for conducting Project Progress Meetings during execution of the construction work.

1.1.2 The Contractor shall schedule and administer Project Progress Meetings at a minimum of one per week and such additional meetings as required, when requested by either the Engineer or the Contractor during any stage of this project when it is deemed necessary to raise any significant questions, establish new guidelines, introduce a new aspect to the project, or address any other items affecting the progress of work. The Contractor shall attend these meetings with all necessary personnel as determined by the Engineer for the duration of this contract. A suggested meeting agenda is provided within this section.

1.1.3 Meetings and conferences shall take place at the project site or some other location that is satisfactory to both the Engineer and the Contractor.

1.2 ATTENDANCE

The following persons shall attend the Progress Meetings:

- Engineer or its representative
- Contractor's Site Superintendent
- Contractor's Project Manager
- Contractor's Key Quality Control Staff
- Contractor's Safety and Health Manager and/or Officer and Emergency Response Coordinator Specialist
- Subcontractors as appropriate to the agenda
- Suppliers as appropriate to the agenda
- Others as requested by the Engineer or as appropriate to the agenda

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The Contractor shall submit the following to the Engineer in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Project Progress Meeting Minutes; Product Data; EA

The Contractor shall be responsible for recording the minutes of Project Progress Meetings including any significant proceedings and decisions arising from the conferences. The Contractor shall reproduce and submit to the Engineer within three calendar days after each meeting three typed copies of the minutes of the meeting. After the Engineer's review and approval, the Contractor shall distribute copies to each participant in the meeting and to parties affected by decisions made at the meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall schedule and administer Project Progress Meetings at a minimum of once per week and additional meetings as required, and if requested by the Engineer.

3.2 GENERAL MEETING REQUIREMENTS

The Contractor shall administer the following general requirements for the Progress Meetings:

- ☐ Prepare agenda for meetings
- ☐ Make physical arrangements for meetings
- ☐ Preside at meetings
- ☐ Record the minutes including a detailed description of proceedings and decisions
- ☐ Reproduce and distribute copies of minutes in accordance with Section 1.3.1

3.3 SUGGESTED AGENDA

The following is a suggested agenda for Project Progress Meetings; the Contractor shall modify this agenda in accordance with ongoing work.

- ☐ Review and approval of minutes of previous meeting
- ☐ Review of Health and Safety
- ☐ Maintenance of quality and safety standards
- ☐ Review of work progress
- ☐ Field observations, problems, conflicts
- ☐ Problems which impede the schedule, and proposed corrective actions
- ☐ Review of offsite materials and equipment delivery schedules
- ☐ Corrective measures and procedures to regain projected schedule
- ☐ Revisions to project schedule
- ☐ Review of planned progress during succeeding work period
- ☐ Coordination of schedules

- Review of submittal schedules; expedite as required
- Discussion of pending changes and substitutions
- Review of proposed changes for effect on construction schedule and on completion date, and effect on other contracts of the project
- Discussion of other business, as appropriate

END OF SECTION

SECTION 01270

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 Summary

This section covers the methods and procedures which will be used to measure the Contractor's work and to provide payment to the Contractor for work performed. It is the responsibility of the Contractor to make a thorough investigation of the drawings, specifications, and the site to determine the scope of work included in each bid item. Payments will be made to the Contractor based on the quantities of work as measured in accordance with the specified methods of measurement and the prices stipulated as shown on the Bidding Schedule. This method of payment will constitute complete compensation for all work shown on the Contract Drawings and provided in the Contract Specifications or other contract documents, and for all costs of accepting the general risks, liabilities and shall include, but not be limited to, compensation for overhead, profit, materials and services, and performing all work required to accomplish and complete the work specified under each item and all other work required.

The work for this project has been divided into two categories, base work and optional items. Work included under base work and optional items have been described in detail in SECTION 01010 - SUMMARY OF WORK.

1.2 Lump Sum Items

1.2.1 The quantities of work performed under lump sum items will not be measured except for the purpose of determining reasonable interim payments.

1.2.2 Interim payments will be made in accordance with the estimated value of work done as determined by the Engineer or as specified in this section. After the award of the contract, the Contractor shall submit a detailed breakdown of all lump sum items that will be used for partial payments.

1.3 Unit Price Items

1.3.1 Payments will be made for unit price items in accordance with the measurement methods set forth in this section or, where specified payment limits are unclear, as determined reasonable by the Engineer, at the unit prices entered in the Bidding Schedule.

1.3.2 Interim measurements and/or payments may be adjusted to account for partially completed work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SECTION A - GENERAL REQUIREMENTS (BID ITEMS 0001 - 0006)

3.1.1 General Conditions (Bid Item 0001)

3.1.1.1 General Conditions shall include all of the items required under these Contract Documents but not covered under other Bid Items, including but not limited to the following: the Contractor's cost for insurance, bonds, fees, permits, and other similar expenses directly related to and required by these Contract Documents; project-dedicated supervisory staff and equipment; compliance with regulatory requirements; pre-construction and construction period planning; scheduling, submittal of plans and documents listed in the submittal register, reporting, preparation of plans; administration; meetings; coordination with utilities, municipalities, subcontractors and disposal facilities; Contractor quality control; environmental protection and spill control; project photographs ; weather monitoring; mobilization and demobilization; record documentation; project signs and any other requirements or related miscellaneous items specified under DIVISIONS 1 and 2.

3.1.1.2 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.1.2 Safety, Health and Emergency Response (Bid Item 0002)

3.1.2.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.1.2.2 Payment for Safety, Health and Emergency Response will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for providing the safety, health and emergency response equipment, facilities and personnel detailed in SECTION 01351 – SAFETY, HEALTH AND EMERGENCY RESPONSE and as otherwise described in the Contract Documents, but not paid for under other Bid Items.

3.1.3 Temporary Facilities and Utilities (Bid Item 0003)

3.1.3.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.1.3.2 Payment for Temporary Facilities and Utilities will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required to install and maintain all temporary facilities and the utilities servicing such facilities at the site during construction in accordance with SECTION 01500 – TEMPORARY CONSTRUCTION FACILITIES AND UTILITIES and as otherwise required by the Contract Documents, but not paid under other Bid Items. It shall include without limitation, the field office and utility services, field office equipment and furnishings, material and equipment storage areas, and portable toilets.

3.1.4 Erosion and Dust Control (Bid Item 0004)

3.1.4.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.1.4.2 Payment for Erosion and Dust Control will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required to comply with the requirements of SECTION 02370 - SOIL EROSION CONTROL, and shall include installation, maintenance, inspection, and repair of all soil erosion and dust control measures for the duration of the construction, and removal at the end of the project.

3.1.5 Surveying (Bid Item 0005)

3.1.5.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.1.5.2 Payment for Surveying will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required to perform and submit all surveys, calculations, drawings and any other requirements found in SECTION 01550 - SURVEYING or as otherwise required by the Contract Documents. Included in this item shall be without limitation, locating all project components prior to construction; interim survey of project components as needed during construction; and surveying the horizontal location and pertinent elevations for all as-built above and below-ground construction items at groundwater treatment facilities for use in preparing the Record Drawings, and surveying the horizontal locations and measuring point elevations of the new wells.

3.1.6 Decontamination (Bid Item 0006)

3.1.6.1 Measurement for this lump sum item shall include all items described under this bid item and no separate unit quantities shall be made.

3.1.6.2 Payment for decontamination will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required to comply with the requirements of SECTION 01351 - SAFETY, HEALTH, AND EMERGENCY RESPONSE. This bid item includes the cost for constructing and removing the decontamination pad, and time for decontamination of drilling and construction equipment during construction phases prior to demobilization.

3.2 SECTION B - SITE WORK (BID ITEMS 0007 - 0013)

3.2.1 Site Preparation (Bid Item 0007)

3.2.1.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.2.1.2 Payment for Site Preparation will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for the complete clearing and grubbing and demolition at the site in accordance with

SECTION 02100 - SITE PREPARATION and as otherwise required by the Contract Documents. It shall include without limitation, the cost to complete clearing, grubbing, stripping and removal of existing pavement. The cost for disposal of waste is included under the Bid Item 0021.

3.2.2 Earthwork (Bid Item 0008)

3.2.2.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.2.2.2 Payment for Earthwork will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, materials, and incidentals required for excavation, trenching, imported material testing and delivery, compaction, grading and testing of all earthen materials, including density testing, in accordance with SECTION 02300 - EARTHWORK.

3.2.3 Yard Piping (Bid Item 0009)

3.2.3.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.2.3.2 Payment for Yard Piping will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for the installation of all yard piping including influent and effluent pipe, valves, fittings, cleanouts and appurtenances in accordance with Section 15200 - PIPING, VALVES AND APPURTNANCES. The cost for trenching, backfill, compaction and grading is included under the Bid Item 0008.

3.2.4 Access Roads (Bid Item 0010)

3.2.4.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.2.4.2 Payment for Access Roads will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for grading, delivery and installation of paved access road from Clinton Road to the Groundwater Treatment Building as shown on the Contract Drawing and in accordance with SECTION 02576 - PAVEMENT.

3.2.5 Fencing and Gates (Bid Item 0011)

3.2.5.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.2.5.2 Payment for Fencing and Gates will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for the installation of fencing and gates as shown on the Contract Drawings and temporary fencing for security and health and safety purposes, in accordance with SECTION 02821 - FENCING and any other requirements of the Contract Documents.

3.2.6 Storm Sewer Connection (Bid Item 0012)

3.2.6.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.2.6.2 Payment for Storm Sewer Connection will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, materials, and incidentals required to connect the effluent pipe from groundwater treatment system to the existing catch basin and modify the existing catch basin construction to allow for continuous effluent discharge and storm sewer water level monitoring. Construction shall allow for field installation of float controls. This bid item shall also include cost to verify that the existing catch basin discharges to the Recharge Basin 124.

3.2.7 Site Restoration (Bid Item 0013)

3.2.7.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.2.7.2 Payment for Site Restoration will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, materials, and incidentals required for seeding, paving, and installation of 30 feet by 50 feet gravel area as shown on the Contract Drawings in accordance with SECTION 02900 - SITE RESTORATION and SECTION 02576 - PAVEMENT and NYSDOT Standard Specification. This bid item shall also include maintenance of seeded areas including fertilizer, mulch, seed, water, and other materials necessary for the establishment of grass areas.

3.3 SECTION C - WELL INSTALLATION (BID ITEMS 0014 - 0019)

3.3.1 Test Borehole (Bid Item 0014)

3.3.1.1 Measurement for this unit price item shall be made to the nearest linear foot of test borehole installation, testing and abandoned.

3.3.1.2 Payment for Test Borehole will be made at the unit price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for drilling the test borehole, sampling and analysis, and grouting and sealing the test borehole in accordance with SECTION 02525 - WELL INSTALLATION AND TESTING.

3.3.2 Extraction Well Installation (Bid Item 0015)

3.3.2.1 Measurement for this unit price item shall be made to the nearest linear foot of well installed.

3.3.2.2 Payment for Extraction Well Installation will be made at the unit price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for drilling and installation of well casing, screen, bentonite, grout and sand as shown on the Contract Drawings and in accordance with SECTION 02525 - WELL INSTALLATION AND TESTING. Transportation and disposal of drill cuttings shall be included under Bid Item 0020 and 0021.

3.3.3 Monitoring Well Installation (Bid Item 0016)

3.3.3.1 Measurement for this unit price item shall be made to the nearest linear foot of monitoring well installed.

3.3.3.2 Payment for Monitoring Well Installation will be made at the unit price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for drilling and installation of well casing, screen, grout, sand and wellhead completion as shown on the Contract Drawings and in accordance with SECTION 02525 - WELL INSTALLATION. Transportation and disposal of drill cuttings shall be included under Bid Item 0020.

3.3.4 Well Development (Bid Item 0017)

3.3.4.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.3.4.2 Payment for Well Development will be made at the lump sum price, for which price and payment will be full compensation for all labor, equipment, material and incidentals required for development of extraction and monitoring wells, and treatment of developed water by an onsite temporary treatment system prior to discharge to storm sewer, in accordance with SECTION 02525 - WELL INSTALLATION.

3.3.5 Extraction Well Testing (Bid Item 0018)

3.3.5.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.3.5.2 Payment for Extraction Well Testing will be made at the lump sum price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for equipment installation, step and yield testing and removal of pumps and piping, monitoring equipment and instrumentation, and chemical sampling and analysis in accordance with SECTION 02525 - WELL INSTALLATION. Onsite treatment of water generated from well testing shall be included under Bid Item 0017.

3.3.6 Extraction Well Pump Installation and Wellhead Completion (Bid Item 0019)

3.3.6.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.3.6.2 Payment for Extraction Well Pump Installation and Wellhead Completion will be made at the lump sum price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for well pump installation and well held completion in accordance with Contract Documents. It shall include, without limitation, the cost to install the well pump and accessories, level transducer, well vault, and vault access door and all hose, pipe, valves, fittings, couplings, gauges, electrical controls, and auxiliary items inside the well vault.

3.4 SECTION D - OFFSITE TRANSPORTATION AND DISPOSAL (BID ITEMS 0020 - 0021)

3.4.1 Transportation and Disposal of Contaminated Material (Bid Item 0020)

3.4.1.1 Soil Cuttings (Bid Item 0020A)

3.4.1.1.1 Measurement for this unit price item will be the actual number of tons of soil cuttings transported and disposed of off-site. Measured quantities shall be based on scale weight tickets provided by the disposal facility. Weight shall be verified prior to payment by submitting three copies of each weight ticket to the Engineer.

3.4.1.1.2 Payment for the Transportation and Disposal of Soil Cuttings will be made at the unit price bid, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for characterization sampling, loading and off-site transportation and disposal of soil cuttings generated from well construction in accordance with the Contract Documents and SECTION 02120 - OFFSITE TRANSPORTATION AND DISPOSAL.

3.4.1.2 Drilling Mud (Bid Item 0020B)

3.4.1.1 Measurement for this unit price item will be the actual number of gallons of contaminated material transported, treated and disposed of off-site.

3.4.1.2 Payment for the Transportation and disposal of Drilling Mud will be made at the unit price bid, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for characterization sampling, off-site transportation, treatment and disposal of drilling mud generated from well construction in accordance with the Contract Documents and SECTION 02120 - OFFSITE TRANSPORTATION AND DISPOSAL.

3.4.2 Transportation and Disposal of Uncontaminated Material (Bid Item 0021)

3.4.2.1 Measurement for this unit price item will be the actual number of tons of uncontaminated material transported and disposed of off-site. Measured quantities shall be based on scale weight tickets provided by the disposal facility. Weight shall be verified prior to payment by submitting three copies of each weight ticket to the Engineer.

3.4.2.2 Payment for the Transportation and Disposal of Uncontaminated Material will be made at the unit price bid, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for characterization sampling, containerizing, loading and off-site transportation and disposal of uncontaminated construction debris and material including clearing and grubbing material, and excess soil from excavation and trenching , in accordance with the Contract Documents.

3.5 SECTION E - GROUNDWATER TREATMENT FACILITY (BID ITEM 0022- 0024)

3.5.1 Groundwater Treatment System (Bid Item 0022)

3.5.1.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.5.1.2 Payment for the Groundwater Treatment System will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for design and approval, procurement, fabrication, delivery, and installation, including process, piping, mechanical, instrumentation, controls, electrical, telemetry and potable water line for the groundwater treatment system in accordance with SECTION 13300 - GROUNDWATER TREATMENT SYSTEM, Division 13 and Division 16. Electrical shall include, without limitation, the cost to install overhead or underground service lines for electric, telephone and broadband; meters; transformers; electric, telephone and broadband service to groundwater treatment system and extraction wells; yard conduit and cable; handholes; groundwater treatment system grounding and lighting protection systems; interior and exterior lighting system; and other site electrical work required to make groundwater treatment systems fully operable.

3.5.2 Treatment Building (Bid Item 0023)

3.5.2.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.5.2.2 Payment for the Treatment Building will be made at the lump sum bid price, for which will be full compensation for all labor, equipment, material, and incidentals required for completion of geotechnical investigation and report for foundation design, and the design, fabrication, delivery, erection, HVAC, mechanical, plumbing, interior and exterior finishing, an accessible unisex toilet room, outside security camera, foundation and concrete slab of the building housing the Groundwater Treatment System, in accordance with SECTION 13122 - GROUNDWATER TREATMENT BUILDING. This bid item shall also include, without limitation, the building sewage disposal system, spill containments, sump, hoist for air stripper tray maintenance, office furnishings, building health and safety provisions and equipment concrete pads (including secondary containment).

3.5.3 System Startup Testing (Bid Item 0024)

3.5.3.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.5.3..2 Payment for System Startup Testing will be made at the lump sum bid price, for which will be full compensation for all labor, equipment, material, and incidentals required for completion of 14-day operational test and 48-hour performance test and to ensure that all groundwater treatment equipment, instrumentation, controls, electric, and telemetry are functioning properly as designed and installed, in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE. All required sampling and start-up testing reporting and the initial testing program report shall be included in this bid item.

3.6 SECTION F - SYSTEM OPERATION, MAINTENANCE AND MONITORING (BID ITEMS 0025 - 0027)

3.6.1 Groundwater Treatment System Operation and Maintenance (O&M) (Bid Item 0025)

3.6.1.1 Measurement for this unit price item shall be to the nearest month of Operation and Maintenance completed.

3.6.1.2 Payment for Groundwater Treatment Plant Operation and Maintenance will be made at the unit price in the bidding schedule, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for one year of operation and maintenance of the groundwater treatment systems and extraction wells as designed and constructed in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE and SECTION 01851 - WELL MAINENANCE PROGRAM. It shall include, without limitation, the cost of chemicals, filter bag replacement, routine extraction well maintenance, routine air stripper maintenance, routine recharge basin maintenance, routine maintenance of other system equipment, maintenance of controls, grounds maintenance, performance and compliance sampling, data evaluation, offsite disposal and associated waste characterization sampling, data reporting, disposal of sewage, disposal of system waste, and utility costs.

3.6.2 Baseline and Site-Wide Groundwater Monitoring (Bid Item 0026)

3.6.2.1 Measurement for this unit price item shall be made for the baseline groundwater monitoring event.

3.6.2.2 Payment for Baseline and Site-Wide Groundwater Monitoring will be made at the unit price in the bidding schedule, for which will be full compensation for all labor, equipment, materials, and incidentals necessary to collect groundwater samples from all wells listed on Table 01800-2 , perform field measurements and analyses using instruments and test kits, package and ship samples to the laboratory, data validation, and data evaluation in accordance with SECTION 01450 - CHEMICAL DATA QUALITY CONTROL and SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENACE. Reporting requirement is included under Bid Item 0025.

3.6.3 Recharge Basin Sand Replacement (Bid Item 0027)

3.6.3.1 Measurement for this unit price item shall be made for each recharge basin sand replacement event.

3.6.3.2 Payment for Recharge Basin Sand Replacement will be made at the unit price in the bidding schedule, for which will be full compensation for all labor, equipment, materials, and incidentals necessary to remove and dispose of the existing sand from the bottom of the recharge basin and replace it with new sand as approved by the Nassau County. Replacement of sand shall be performed on an as needed basis as approved by the Engineer. Routine recharge basin maintenance is included under Bid Items 0025.

3.7 SECTION G - OPTIONAL ITEMS - IRON REMOVAL TREATMENT SYSTEM (BID ITEMS 0028 - 0032)

3.7.1 General Conditions (Bid Item 0028)

3.7.1 Measurement and payment for the General Conditions lump sum item shall include cost for all items described under Bid Items 0001 through 0003 for additional cost incurred for the implementation of the pilot testing and installation of the iron removal system.

3.7.2 Pilot Testing (Bid Item 0029)

3.7.2.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.7.2.2 Payment for Pilot Testing will be made at the lump sum bid price, for which will be full compensation for all labor, equipment, material, and incidentals required for the completion of pilot testing for the iron removal treatment system design including without limitation groundwater sampling, field measurements, laboratory analysis and data evaluation in accordance with SECTION 13300 - GROUNDWATER TREATMENT SYSTEM and SECTION 01450 - CHEMICAL DATA QUALITY CONTROL.

3.7.3 Treatment Building (Bid Item 0030)

3.7.3.1 Measurement and payment for the Treatment Building lump sum item shall include additional cost incurred to construct larger treatment building for accommodation of the iron removal system, in accordance with SECTION 13122 - GROUNDWATER TREATMENT BUILDING.

3.7.4 Iron Removal System and Testing (Bid Item 0031)

3.7.4.1 Measurement for this lump sum item shall include all items described under this bid item and no separate quantity measurement shall be made.

3.7.4.2 Payment for the Iron Treatment System will be made at the lump sum bid price, for which price and payment will be full compensation for all labor, equipment, material, and incidentals required for design and approval, procurement, fabrication, shop testing, delivery, installation, including process, piping, mechanical, and instrumentation, and system startup testing in accordance with SECTION 13300 - GROUNDWATER TREATMENT SYSTEM and SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE .

3.7.5 Groundwater Treatment System O&M (Bid Item 0032)

3.7.5.1 Measurement and payment for the Groundwater Treatment System O&M will be made at the unit price in the bidding schedule for additional cost incurred for operation and maintenance of the iron removal system as designed and constructed in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE.

END OF SECTION

SECTION 01310

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall provide all services required to assure site safety, site security, site communication, project management, record keeping and individual additional task performance. These services shall include the provision of qualified personnel to be accepted by the Engineer and the equipment necessary to complete the performance of such tasks.

1.2 SUBMITTALS

Engineer approval is required for submittals with an "EA" designation; submittals having an "FIO" designation are for information only. The Contractor shall submit the following to the Engineer in accordance with SECTION 01330 – SUBMITTAL PROCEDURES:

1.2.1 Project Organizational Chart; Pre-Construction Submittals; EA

The Contractor shall submit an organizational chart including all personnel to be used on the project prior to Pre-Construction Conference.

1.2.2 Project Manager Name and Experience; Pre-Construction Submittals; EA

The Contractor shall submit the name and experience of the Project Manager for the project within 14 calendar days from Notice to Proceed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SITE SAFETY

The Contractor shall be responsible for the safe operation of the work at the site and shall employ a Safety and Health Manager (SHM) and a Site Safety and Health Officer (SSHO). These individuals shall be responsible for the administration of site health and safety, and shall have the responsibilities as defined in SECTION 01351 - SAFETY, HEALTH AND EMERGENCY RESPONSE.

3.2 QUALITY CONTROL

The Contractor shall be responsible for the overall management of quality control and shall have the overall responsibility for quality control as defined in SECTION 01451 - CONTRACTOR QUALITY CONTROL.

3.3 PROJECT MANAGEMENT AND RECORDKEEPING

3.3.1 The Contractor shall provide an overall project management team including a Project Manager and administrative personnel qualified and capable of providing management for the project including construction supervision, expediting labor relations, staffing and recordkeeping. The Contractor shall submit a detailed Project Organizational Chart, which shows the key individuals directly involved in the project.

3.3.2 The Project Manager shall take overall responsibility for conducting the work and for assuring that the work is conducted in accordance with the requirements of the Contract Documents. The Project Manager shall be responsible for communication and information exchange with the Engineer and shall officially represent the Contractor in all project related activities. The Project Manager, at a minimum, shall have authority to sign payments and change orders. The Contractor shall submit within 14 calendar days following the Notice to Proceed, the name and experience of the Project Manager in writing to the Engineer.

3.3.3 The Contractor shall make available in a timely manner records of all site activity, quantities of materials delivered to the site, quantities of materials utilized, soils excavated, treated water discharged from treatment plant, waste quantities produced, laboratory results, waste transportation activity information and all other information required to support requests for payment.

3.3.4 A minimum of 14 calendar days before mobilization, the Project Manager and the Engineer shall meet with the Garden City Plaza owner, Nassau County engineers and the village of Garden City. The parties will discuss the planned construction approach and phasing of work.

Items to be discussed shall include, but are not limited to:

- Planned construction methods to be used
- Review the type and size of equipment and operating procedures including heavy equipment operations, mechanical equipment operations, etc
- Review the effect of construction on overhead and buried utilities
- Review the community protection requirements
- Planned work hours and access to the site
- Emergency contact procedures

The Contractor shall record the minutes of the meeting and include all significant proceedings and decisions.

3.4 WORKING HOURS

3.4.1 Working hours shall be scheduled by the Contractor to meet the construction schedule in consultation with the Garden City Plaza owner and village of Garden City official and approved by the Engineer.

END OF SECTION

SECTION 01320

PROJECT SCHEDULES

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, materials, equipment, and incidentals required to prepare and update critical path method project schedules, and prepare the monthly progress reports for review at the Pre-Construction Conference and subsequent progress meetings. The project schedule shall be prepared based on the substantial completion date specified in Division 0 (Contract Documents) of the specifications.

1.1.2 The Contractor shall prepare and update the project schedule using a computer software system that produces legible, easily updated critical path schedules. The Contractor shall submit the software to the Engineer for approval prior to use.

1.2 FORM OF SCHEDULES

1.2.1 The Contractor shall prepare the critical path schedules in the form of a bar chart with the following details.

1.2.1.1 Identify the project at the top of the project schedule.

1.2.1.2 Provide a separate horizontal bar for each work activity or operation.

1.2.1.3 Provide bold vertical lines, at one-week intervals, with consecutive numbering of each week on the horizontal time scale.

1.2.1.4 Identify the first work day of each work item on the horizontal time scale.

1.2.1.5 The chronological order of the start of each major operation or segment of work will determine the vertical location of its bar on the chart.

1.2.1.6 The sheet size shall be as approved by the Engineer.

1.3 SUBMITTALS

Engineer approval is required for submittals with an "EA" designation; submittals having an "FIO" designation are for information only. The Contractor shall submit the following to the Engineer in accordance with SECTION 01330 – SUBMITTAL PROCEDURES:

1.3.1 Initial Project Schedule; Pre-Construction Submittals; EA

Submit initial project schedule for approval within 15 days after Notice of Award is made. Project schedule to start with the Notice to Proceed date and end at project completion and demobilization.

1.3.2 Revised Project Schedule; Pre-Construction Submittals; EA

Submit revised project schedule, if necessary, for approval within five (5) days after date of the Notice to Proceed and during each regular monthly progress meeting.

1.3.2.1 The Engineer will review schedules and return a reviewed copy within seven (7) days after receipt.

1.3.2.2 If required, the Contractor shall resubmit a revised schedule within seven (7) days after return of reviewed copy.

1.4 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS, a Project Schedule as described below shall be prepared. The scheduling of design and construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Designers, subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, and to aid in evaluating time extensions, and to provide the basis of all progress payments.

3.1.1 Approved Project Schedule

The Contractor shall use the approved Project Schedule to measure the progress of the work and to aid in evaluating time extensions. The schedule shall be cost loaded and activity coded. The schedule will provide the basis for all progress payments. If the Contractor fails to submit any schedule within the time prescribed, the Engineer may withhold approval of progress payments until the Contractor submits the required schedule.

3.1.2 Schedule Status Report

Provide a Schedule Status Report on at least a monthly basis. If, in the opinion of the Engineer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress including those that may be required by the Engineer, without additional cost to the Government. In this circumstance, the Engineer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction planned, and to submit for approval any supplementary schedule or schedules as the Engineer deems necessary to demonstrate how the approved rate of progress will be regained.

3.1.3 Default Terms

Failure of the Contractor to comply with the requirements of the Engineer shall be grounds for a determination by the Engineer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Engineer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of the contract.

3.2 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Engineer.

3.2.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in the Precedence Diagram Method (PDM).

3.2.2 Level of Detail Required

The Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Engineer at the appropriate level of detail, as specified by the Engineer, shall result in the disapproval of the schedule. The Engineer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule:

3.2.2.1 Activity Durations

Contractor submissions shall follow the direction of the Engineer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods.

3.2.2.2 Design and Permit Activities

Design and permitting activities, including necessary conferences and follow-up actions and design package submission dates, shall be integrated into the schedule.

3.2.2.3 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, and delivery.

3.2.2.4 Critical Activities

The following activities shall be listed as separate line activities on the Contractor's project schedule:

- Submittal and approval of all required plans
- Mobilization for well drilling, extraction wells sampling, and geotechnical investigations
- Installation of extraction wells, step testing, and pump testing
- Installation of monitoring wells
- Extraction wells sampling
- Geotechnical investigation for building foundation design
- Iron treatment system pilot testing, if necessary
- Mobilization for construction activities
- Clearing and grubbing
- Earthwork and piping
- Treatment building construction
- Installation of treatment equipments and control
- Baseline groundwater sampling
- Treatment system start-up and testing
- Site restoration
- Pre-final inspection
- Correction of punch list from pre-final inspection
- Final inspection
- Project close-out and demobilization

3.2.2.5 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, and Notice to Proceed (NTP) for phasing requirements.

3.2.2.6 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, Contractor work force, or government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

3.2.2.7 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

3.2.2.8 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a modification or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Modification or Claim Number. Whenever possible, changes shall be added to the schedule by adding new activities. Existing activities shall not normally be changed to reflect modifications.

3.2.2.9 Bid Item

All activities shall be identified in the Project Schedule by the Bid Item to which the activity belongs. An activity shall not contain work in more than one Bid Item. The Bid Item for each appropriate activity shall be identified by the Bid Item Code.

3.2.2.10 Phase of Work

All activities shall be identified in the Project Schedule by the phase of work in which each activity occurs. Activities shall not contain work in more than one phase of work.

3.2.2.11 Category of Work

All Activities shall be identified in the project schedule according to the category of work which best describes the activity. Category of work refers, but is not limited, to the procurement chain of activities including such items as submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing.

3.2.2.12 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to, a work breakdown structure for the project

3.2.3 Scheduled Project Completion

The schedule interval shall extend from the contract start date to the contract completion date. The contract completion activity (End Project) shall finish based on the required contract duration in the accepted contract proposal, as adjusted for any approved contract time extensions. The first scheduled work period shall be the day after NTP is acknowledged by the Contractor.

3.3.1.1 PROGRESS REVISIONS

3.3.1 Indicate progress of each activity to date of submission.

3.3.2 Show changes occurring since previous submission of schedule with the following details:

- Show major changes in scope or quantities (if any).
- Show activities modified since previous submission.
- Show revised projections of progress and completion.
- Show other identifiable changes.

3.3.3 Provide a very brief narrative report as needed to define:

- Problem areas, anticipated delays, and the impact on schedule.
- Recommended corrective action and its effect.
- The effect of changes, if any, on schedules of subcontractors.

3.4 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, or any interim milestone date, the Contractor shall furnish the following for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract: justification, project schedule data, and supporting evidence as the Engineer may deem necessary. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is required for any approvals.

3.4.1 Justification of Delay

The Project Schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Engineer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, shall not be a cause for a time extension to the contract completion date.

3.4.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date based upon the most recent schedule update. Such a request shall include, as a minimum:

- A list of affected activities, with their associated project schedule activity number
- A brief explanation of the causes of the change
- An analysis of the overall impact of the changes proposed

3.5 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Engineer within 14 calendar days of the NTP being issued. The proposed revisions to the schedule will be approved by the Engineer prior to inclusion of those changes within the Project Schedule. If the Contractor fails to submit the proposed revisions, the Engineer may furnish the Contractor with suggested revisions to the Project Schedule. The Contractor shall include these revisions in the Project Schedule until revisions are submitted and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Engineer, the Contractor shall advise the Engineer within 14 calendar days of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Engineer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 14 calendar days of receipt of the Engineer's proposed revisions, the Contractor will be deemed to have concurred with the Engineer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

END OF SECTION

SECTION 01330

SUBMITTALS PROCEDURES

PART 1 GENERAL

1.1 SUBMITTAL IDENTIFICATION

1.1.1 The submittals described herein are those required, and further described in other sections of the specifications, for acceptance by the Engineer. Other requirements pertaining to submittals may be included in the Special Clauses.

1.2 SUBMITTAL REQUIREMENTS

1.2.1 Submittals Requiring Approval

Approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Engineer.

1.2.2 Information Only Submittals

All submittals not requiring approval will be for information only.

1.3 APPROVED SUBMITTALS

Engineer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor's Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Engineer, no resubmits for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Engineer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the Contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Engineer.

1.5 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall make submittals as required by the specifications. The Engineer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same used in the Contract Drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with Contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including, but not limited to, catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; Operation and Maintenance (O&M) manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of, in accordance with manufacturers Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

3.2 SUBMITTAL REGISTER

At the end of this section is a Submittal Register listing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required.

3.3 SCHEDULING

3.3.1 Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 21 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delays, damages, or time extensions will be allowed for time lost in late submittals.

3.3.2 The Engineer will review the Submittal Register for approval action.

3.3.3 The approved register will become a part of the contract and Contractor shall be subject to the requirements thereof. The Contractor shall revise and/or update the register monthly to take into account all changes in the contract. Each such revised addition and/or revision to the register shall be submitted to the Engineer for approval. This register and the progress schedules shall be coordinated.

3.4 TRANSMITTAL FORM

The sample Transmittal Form attached to this section shall be used for submitting both submittal requiring approval and information only submittals in accordance with instructions on the reverse side of the form. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care will be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

3.5 SUBMITTAL PROCEDURE

Submittals shall be made as follows:

3.5.1 Procedures

The Contractor shall submit four copies, each with separate transmittal, to the Engineer in accordance with the "Submittal Register." The mailing address for these submittals shall be obtained at the Pre-Construction Conference. Items not to be submitted in quadruplicate, such as material samples, shall be submitted accompanied by four copies of the submittal register.

3.5.2 Deviations

For submittals that include proposed deviations requested by the Contractor, the column "variation" of the submittal register shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Engineer reserves the right to rescind approval of submittals containing unnoted deviations.

3.5.3 The Contractor shall submit items listed on the Contract Drawings and listed or specified in the other sections of these specifications. The Engineer may request submittals in addition to those listed when deemed necessary to adequately describe the work covered in the respective sections. Each submittal shall be completed and in sufficient detail for ready determination of compliance with the contract requirements.

3.6 CONTROL OF SUBMITTALS

The Contractor shall carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

3.7 APPROVED SUBMITTALS

Upon completion of review of submittals requiring approval, the submittals will be identified as having received approval by being so stamped and dated. Three copies of the submittal will be retained by the Engineer and one copy of the submittal will be returned to the Contractor.

3.8 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Engineer is not required on information only submittals. The Engineer reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications and will not prevent the Engineer from requiring removal and replacement of nonconforming material incorporated in the work.

3.9 RESUBMISSION REQUIREMENTS

3.9.1 Make any corrections or changes in the submittals required by the Engineer and resubmit until approved.

3.9.3 Revise initial drawings or data, and resubmit as specified for the initial submittal.

3.9.4 Indicate any changes which have been made other than those requested by the Engineer.

3.9.5 Samples: Submit new samples as required for initial submittal.

3.10 PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

If specifically required in other Sections of these Specifications, the Contractor shall submit a New York P.E. Certification for each item required, in the form attached to this Section, completely filled in and stamped.

3.11 SHOP DRAWINGS, SAMPLES, AND PROJECT DATA

3.11.1 Shop Drawings

3.11.1.1 Shop drawings, as defined in the Contract Clauses and as specified in individual sections include, but are not necessarily limited to, fabrication and erection/installation drawings, schedule information and coordination drawings, as applicable to the work.

3.11.1.2 All details on shop drawings shall clearly show elevations of structures and field verification of structure measurements.

3.11.1.3 All calculations used to develop designs shall be submitted with the detailed shop drawings.

3.11.2 Samples

Samples specified in individual sections include, but are not necessarily limited to, physical examples of the items to be used in the work.

3.11.3 Product Data

Product data, as specified in individual sections include, but are not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation or use instructions, manufacturer's printed statements of compliance and applicability, catalog cuts, product photographs, production or quality control inspection and test reports and certificates.

3.13 CONTRACTOR'S RESPONSIBILITIES

3.13.1 The Contractor shall review shop drawings, product data and samples prior to submission to determine and verify the following:

- Field measurements
- Field construction criteria

3.13.2 The review and approval of shop drawings or samples by the Engineer shall not relieve the Contractor from its responsibility with regard to the fulfillment of the terms of the contract. All risks of error and omission are assumed by the Contractor, and the Engineer will have no responsibility.

3.13.3 No portion of the work requiring a shop drawing, working drawings, sample, or catalog data shall be started nor shall any materials be fabricated, installed or used on the sites prior to the approval of the Engineer. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall be at the Contractor's risk. The Engineer will not be liable for any expense for delay due to corrections or remedies required to accomplish conformity.

3.13.4 Project Work, materials, fabrication and installation shall conform to approved shop drawings, working drawings, applicable samples, and catalog data.

P. E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a Professional Engineer registered in the State

of ______New York______ and that he/she has been employed by

__________________ to design__________________________(Name of Contractor) (Insert P.E. Responsibilities)
in accordance with Specification Section ______________ for the

____.
(Name of Project)

The undersigned further certifies that he/she has performed the design of the

____, that said
(Name of Project)

design is in conformance with all applicable local, state and federal codes, rules, and regulations, and that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the Engineer within seven days following written request therefore by the Engineer.

______________	P. E. Name
______________	Signature
______________	Address
______________	Contractor's Name
______________	Signature
______________	Title
______________	Address

END OF SECTION

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE (*Read instructions on the reverse side prior to initiating this form*)	DATE	TRANSMITTAL NO.

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS *(This section will be initiated by the contractor)*

TO:	FROM:	CONTRACT NO.	CHECK ONE: ☐ THIS IS A NEW TRANSMITTAL ☐ THIS IS A RESUBMITTAL OF TRANSMITTAL ________
SPECIFICATION SEC. NO. *(Cover only one section with each transmittal)*	PROJECT TITLE AND LOCATION		CHECK ONE: THIS TRANSMITTAL IS FOR ☐ INFO ONLY ☐ APPROVAL

ITEM NO. a.	DESCRIPTION OF ITEM SUBMITTED *(Type size, model, number / etc.)* b.	MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. (See instruction no. 8) c.	NO. OF COPIES d.	CONTRACT REFERENCE DOCUMENT SPEC. PARA. NO. e.	CONTRACT REFERENCE DOCUMENT DRAWING SHEET NO. f.	FOR CONTRACTOR USE CODE g.	VARIATION *(See instruction No. 6)* h.	FOR ENGINEER USE CODE i.

REMARKS	**I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.** ________________________ NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED *(List by Item No.)*	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.

2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; on resubmittals, insert transmittal number of last submission as well as the new submittal number.

3. The "Item No." will be the same "Item No." as indicated on the submittal register for each entry on this form.

4. Submittals requiring expeditious handling will be submitted on a separate form.

5. Separate transmittal form will be used for submittals under separate sections of the specifications.

6. A check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications--also, a written statement to that effect shall be included in the space provided for "Remarks".

7. Form is self-transmittal, letter of transmittal is not required.

8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.

9. EPA's approving authority will assign action codes as indicated below in space provided in Section I, column I to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g, to each item submitted.

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

A -- Approved as submitted.

B -- Approved, except as noted on drawings.

C -- Approved, except as noted on drawings. Refer to attached sheet resubmission required.

D -- Will be returned by separate correspondence.

E -- Disapproved (See attached).

F -- Receipt acknowledged.

FX -- Receipt acknowledged, does not comply as noted with contract requirements.

G -- Other (*Specify*)

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

TITLE AND LOCATION: OLD ROOSEVELT FIELD SUPERFUND SITE, GARDEN CITY, NASSAU COUNTY, NY																CONTRACTOR		
				TYPE OF SUBMITTAL											CLASSIFICATION		
NAS ACTIVITY CODE	ITEM NUMBER	SPECS PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	PRECONST SUBMITTAL	SHOP DRAWINGS	PRODUCT DATA	SAMPLES	DESIGN DATA	TEST REPORTS	CERTIFICATES	MFRS INSTRUCTIONS	MFRS FIELD REPORTS	O&M DATA	CLOSEOUT SUBMITTAL	INFORMATION ONLY	ENGINEER APPROVED	REVIEWER
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
		01201–1.5.1	Conference Meeting Minutes			X										X	
		01202–1.3.1	Project Progress Meeting Minutes			X										X	
		01310–1.2.1	Project Organizational Chart	X												X	
		01310–1.2.2	Project Manager Name and Experience	X												X	
		01320–1.3.1	Initial Project Schedule	X												X	
		01320–1.3.2	Revised Project Schedule	X												X	
		01351–1.3.1	Site Safety and Health Plan	X												X	
		01351–1.3.2	Weekly Safety and Accident Reports			X									X		
		01351–1.3.3	Air Monitoring Data			X									X		
		01351–1.3.4	Personnel Health and Safety Certificates							X					X		
		01351–1.3.5	Safety and Health Manager Statements							X					X		
		01351–1.3.6	Certificate of Worker/Visitor Acknowledgement							X					X		
		01351–1.3.7	Project Safety and Health Phase-Out Report											X	X		
		01355–1.3.1	Environmental Protection Plan	X												X	
		01380–1.2.1	Project Photographs			X									X		
		01450–1.3.1	Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP)	X												X	

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				TYPE OF SUBMITTAL											CLASSIFICATION		
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a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
		01450–1.3.2	ANSETS Data Requirement Form and Trip Report						X						X		
		01450–1.3.3	Topsoil Material Testing Results						X							X	
		01450–1.3.4	Analytical Data						X							X	
		01450–1.3.5	Non-Conformance Reports						X						X		
		01450–1.3.6	Chemical Data Final Report (CDFR)						X							X	
		01451–1.3.1	CQC Plan	X												X	
		01451–1.3.2	CQC Organizational Changes			X										X	
		01451–1.3.3	CQC Reports			X									X		
		01500–1.2.1	Temporary Site Facility Layout Plan		X											X	
		01550–1.2.1	Surveyor Qualifications			X									X		
		01550–1.2.2	Surveyor Accuracy Documentation			X									X		
		01550–1.2.3	Surveyor Field Notes			X									X		
		01550–1.2.4	As-Built Drawings											X		X	
		01780–1.3.1	Interim Remedial Action (RA) Report											X		X	
		01800–1.2.1	Notification of Maintenance Activities										X		X		
		01800–1.2.2	Monthly Operating Logs										X		X		
		01800–1.2.3	Initial Testing Program (ITP) Report						X						X		
		01800–1.2.4	Quaterly Remedial Progress Reports						X						X		

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a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
		01800--1.2.5	Computerized Recordkeeping System										X			X	
		01800--1.2.6	Optimization Report						X						X		
		01850--1.3.1	System O&M Manual										X			X	
		01850--1.3.2	User Startup Training and Instruction Schedule	X												X	
		01850--1.3.3	Proposed Changes to the O&M Manual										X			X	
		01851--1.2.1	Chemical Additives and Agents			X										X	
		01851--1.2.2	Extraction Well Testing Results						X						X		
		02100--1.3.1	Site Preparation Plan	X												X	
		02100--1.3.2	Crushed Stone Aggregate Certificates of Compliance							X					X		
		02100--1.3.3	Geotextile Filter Fabric Certificates of Compliance							X					X		
		02100--1.3.4	Permits							X					X		
		02120--1.3.1	Transportation Plan	X												X	
		02120--1.3.2	Notice of Non-Compliance and Notice of Violation			X									X		
		02120--1.3.3	Transport Certification							X					X		
		02120--1.3.4	Annual and Biennial Reports						X							X	
		02120--1.3.5	Shipping Documents and Packaging Certification							X						X	

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NAS ACTIVITY CODE	ITEM NUMBER	SPECS PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	TYPE OF SUBMITTAL: PRECONST SUBMITTAL	SHOP DRAWINGS	PRODUCT DATA	SAMPLES	DESIGN DATA	TEST REPORTS	CERTIFICATES	MFRS INSTRUCTIONS	MFRS FIELD REPORTS	O&M DATA	CLOSEOUT SUBMITTAL	CLASSIFICATION: INFORMATION ONLY	ENGINEER APPROVED	REVIEWER
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
		02120–1.3.6	EPA Off-Site Policy							X					X		
		02120–1.3.7	Certificates of Disposal							X					X		
		02120–1.3.8	Disposal Facility Names and Permits	X												X	
		02300–1.3.1	Excavation, Trenching, and Backfill Plan	X												X	
		02300–1.3.2	Laboratory and Field Test Results						X						X		
		02300–1.3.3	Earthen Materials Certificates of Compliance							X					X		
		02370–1.3.1	Soil Erosion and Sediment Control Plan	X												X	
		02370–1.3.2	Samples				X									X	
		02370–1.3.3	Permits							X					X		
		02510–1.3.1	Valves		X											X	
		02510–1.3.2	Material List			X										X	
		02510–1.3.3	Satisfactory Installation			X										X	
		02510–1.3.4	Certificates of Compliance							X					X		
		02510–1.3.5	Hydrostatic Testing and Disinfection						X							X	
		02510–1.3.6	Installation Instructions								X				X		
		02525–1.3.1	Lithologic (Boring) Logs			X										X	
		02525–1.3.2	Well Installation Reports			X									X		

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a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
		02525--1.3.3	Well Development Records							X						X	
		02525--1.3.4	Well and Test Boring Abandonment Records							X						X	
		02525--1.3.5	Field Notebooks							X						X	
		02525--1.3.6	Catalog Data			X									X		
		02525--1.3.7	Grain Size Distribution Test Results						X							X	
		02525--1.3.8	Filter Pack Grading Data						X							X	
		02525--1.3.9	Well Testing and Sampling						X							X	
		02525--1.3.10	Qualifications							X					X		
		02525--1.3.11	Permits and Licenses							X					X		
		02525--1.3.12	Utility Clearance Records							X					X		
		02525--1.3.13	Drilling Methods	X												X	
		02525--1.3.14	Water Sample Results						X							X	
		02576--1.3.1	Certified Mix Designs	X												X	
		02576--1.3.2	Certified Test Results for Gravel Gradation					X							X		
		02821--1.3.1	Fencing		X											X	
		02821--1.3.2	Material Certificates							X					X		
		02900--1.3.1	Material Certificates							X						X	
		03100--1.3.1	Detail Drawings		X											X	

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a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
		03100--1.3.2	Form Design			X										X	
		03100–1.3.3	Form Materials			X										X	
		03100–1.3.4	Form Releasing Agents				X									X	
		03100–1.3.5	Form Releasing Agents								X				X		
		03100–1.3.6	Certificates							X					X		
		03150–1.3.1	Product Data			X										X	
		03150–1.3.2	Certifications							X					X		
		03200–1.3.1	Reinforcing Steel Shop Drawings		X											X	
		03200–1.3.2	Mill Test Reports						X							X	
		03200–1.3.3	Welder's Certification							X					X		
		03300–1.3.1	Mixture Proportions			X										X	
		03300–1.3.2	Testing and Inspection for Contractor Quality Control						X						X		
		03300–1.3.3	Qualifications, Manufacturer's Certification							X					X		
		03410–1.3.1	Shop Drawings		X											X	
		03410–1.3.2	Design Data						X							X	
		03410–1.3.3	Test Reports						X							X	
		03410–1.3.4	Material Certificates							X					X		

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a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
		03410–1.3.5	Compliance Certificates							X					X		
		11319–1.3.1	Pump Selection Calculations and Performance Data		X											X	
		11319–1.3.2	Manufacturer's Installation Instructions								X				X		
		11319–1.3.3	Manufacturer's Descriptive Data			X									X		
		11319–1.3.4	Technical Literature			X									X		
		11319–1.3.5	Manufacturer's Certified Pump Curve			X									X		
		11319–1.3.6	Corrosion Protection Certificate							X					X		
		11319–1.3.7	O&M Manual					X							X		
		13122–1.2.1	Building Layout Drawings	X												X	
		13122–1.2.2	Structural Drawings and Specifications	X												X	
		13122–1.2.3	HVAC, Plumbing, and Fire Protection Drawings and Specifications	X												X	
		13122–1.2.4	Shop Drawings		X											X	
		13122–1.2.5	Color Samples				X									X	
		13122–1.2.6	P.E. Certification							X					X		
		13122–1.2.7	Erection Drawings		X											X	
		13122–1.2.8	Manufacturer's Certifications							X					X		

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a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
		13122--1.2.9	Warranty							x					x		
		13122--1.2.10	Sanitary Waste Holding Tank Permit							x					x		
		13300--1.2.1	Pilot Testing Plan	x												x	
		13300--1.2.2	Groundwater Treatment Plan	x												x	
		13300--1.2.2.1	Groundwater Treatment Equipment			x										x	
		13300--1.2.2.2	Process Flow and Instrumentation Diagrams		x											x	
		13300--1.2.2.3	Plan and Cross-Sectional View of Treatment System Layout		x											x	
		13300--1.2.5	Equipment Certificates							x					x		
		13300--1.2.6	Calculations					x								x	
		13300--1.2.7	Test Reports						x							x	
		13300--1.2.8	Warranty							x					x		
		13300--1.2.9	Hardware and Software Design					x								x	
		15200--1.3.1	Shop Drawings		x											x	
		15200--1.3.2	Product Data			x										x	
		15200--1.3.3	Statements of Satisfactory Installation and Thrust Restraint Methods						x						x		
		15200--1.3.4	Equipment Samples as Appropriate				x								x		

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a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
		15200–1.3.5	Design Data and Assumptions					X								X	
		15200–1.3.6	Certified Shop Tests							X					X		
		15200–1.3.7	Performance Testing						X						X		
		15200–1.3.8	Certification							X					X		
		15200–1.3.9	Manufacturer's Certification							X					X		
		15200–1.3.10	Equipment/System Warranty							X					X		
		16000–1.3.1	Shop Drawings		X											X	
		16000–1.3.2	Manufacturer's Product Information			X										X	
		16000–1.3.3	Electrical Installation Drawings		X											X	
		16000–1.3.4	Test Reports						X						X		
		16110–1.2.1	Product Data			X									X		
		16110–1.2.2	Samples				X								X		
		16191–1.2.1	Catalog Information			X										X	
		16220–1.3.1	Motor Data			X										X	
		16220–1.3.2	Dimension Drawings		X											X	
		16220–1.3.3	Equipment Guarantee							X					X		
		16220–1.3.4	Equipment Warranty							X					X		

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a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
		16261–1.3.1	Shop Drawings		X											X	
		16261–1.3.2	Equipment Data			X										X	
		16261–1.3.3	Test Reports						X						X		
		16261–1.3.4	Manufacturer's Instructions								X				X		
		16261–1.3.5	Manufacturer's Field Reports									X			X		
		16261–1.3.6	Equipment Warranty							X					X		
		16375–1.4.1	Manufacturer's Catalog Data			X										X	
		16375–1.4.2	Material, Equipment, and Fixtures List			X										X	
		16375–1.4.3	Electrical Distribution System Drawings		X											X	
		16375–1.4.4	Factory Test						X						X		
		16375–1.4.5	Field Testing Plan						X							X	
		16375–1.4.6	Test Reports						X							X	
		16375–1.4.7	Materials and Equipment Certificates							X						X	
		16402–1.3.1	Manufacturer's Catalog			X										X	
		16402–1.3.2	Material, Equipment, and Fixtures Lists			X										X	
		16402–1.3.3	Installation Procedures			X										X	
		16402–1.3.4	Interior Electrical Equipment Drawings		X											X	
		16402–1.3.5	Structural Drawings		X											X	
		16402–1.3.6	Electrical Drawings		X											X	

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		16402--1.3.7	Onsite Test						x							x	
		16402--1.3.8	Factory Test Reports						x							x	
		16402--1.3.9	Field Test Plan						x							x	
		16402--1.3.10	Field Test Reports						x							x	
		16402--1.3.11	Materials and Equipment Certificates							x						x	
		16502--1.3.1	Lighting Protection System		x											x	
		16502--1.3.2	Lighting Protection System					x								x	
		16600--1.4.1	Shop Drawings		x											x	
		16600--1.4.2	Product Data			x										x	
		16660--1.3.1	Shop Drawings		x											x	
		16660--1.3.2	Product Data			x										x	
		16660--1.3.3	Test Results						x							x	
		16742--1.4.1	Shop Drawings		x											x	
		16742--1.4.2	Spare Parts			x										x	
		16742--1.4.3	Manufacturer's Recommendations								x					x	
		16742--1.4.4	Test Plan						x							x	
		16742--1.4.5	Qualifications	x												x	
		16742--1.4.6	Test Reports						x						x		
		16742--1.4.7	Materials and Equipment							x					x		
		16742--1.4.8	Operation and Maintanence Data										x		x		

SECTION 01351

SAFETY, HEALTH, AND EMERGENCY RESPONSE

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This section provides requirements for developing and implementing a Site Safety and Health Plan (SSHP) that is required by the Contractor's Safety and Health Manager (SHM). The requirements shall apply to work performed in both "contaminated" and "clean" areas.

1.1.2 This section describes the responsibilities of the Contractor for safety, health, and emergency response. The work performed under these specifications shall be actively managed so as to:

- Prevent injuries to employees or other persons
- Maintain employee exposures to health hazards well below the occupational limits established by Occupational Safety and Health Administration (OSHA) or American Conference of Governmental Industrial Hygienists (ACGIH)
- Prevent increasing contaminant levels in soil, water, and sediment near the site

Any disregard for the provisions of these safety and health requirements shall be deemed just and sufficient cause for termination of the contract without compromise or prejudice to the rights of the Contractor.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply. If conflicts exist between these standards, regulations, or requirements, the most stringent of the documents shall apply.

<u>AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)</u>

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

Guide to Occupational Exposure Values

<u>AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)</u>

ANSI Z87.1	Occupational and Educational Eye and Face Protection
ANSI Z88.2	Respiratory Protection
ANSI Z89.1	Safety Requirements for Industrial Head Protection
ANSI Z9.4	Ventilation and Safe Practices of Abrasive Blasting Operations

ANSI Z358.1	Emergency Eyewash and Shower Equipment

AMERICAN PETROLEUM INSTITUTE (API)

API RP 2003	Protection Against Ignition Arising Out of Static, Lightning, and Stray Currents
API Publ 2219	Safe Operation of Vacuum Trucks in Petroleum Service

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM F2412-05	Standard Test Methods for Foot Protection
ASTM F2413-05	Standard Specification for Performance Requirements for Foot Protection

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1904	Recording and Reporting Occupational Injuries and Illnesses
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 302	Designation, Reportable Quantities, and Notification
41 CFR Part 50-204	Safety and Health Standards for Federal Supply Contracts
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

FEDERAL ACQUISITION REGULATION

52.236.13	Accident Prevention Clause

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH Pub No. 85-115	Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities
NIOSH	Manual of Analytical Methods, 4th. Edition, Volumes 1 and 2
NIOSH	Pocket Guide to Chemical Hazards, Pub No. 2001-45

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

OSHA	Industrial Hygiene Field Technical Manual
TED 01-00-015	OSHA Technical Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA	Standard Operating Safety Guides, July 1988

EPA	Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)
EPA	Air Quality Guidelines - National Ambient Air Quality Standards (NAAQS)
Order 1440.2	Health and Safety Requirements for Employees Engaged in Field Activities

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The Contractor shall provide each of the following documents to the Engineer in accordance with SECTION 01330 - SUBMITTAL PROCEDURES. The Contractor shall maintain a copy of all documents described in this section onsite at all times during construction.

1.3.1 Site Safety and Health Plan; Pre-Construction Submittals; EA

The Contractor shall submit the SSHP to the Engineer at least 21 calendar days prior to Pre-Work conference. The SSHP must be approved by the Engineer prior to commencement of field activities. The Contractor shall allow 30 calendar days for the approval process.

A SSHP shall address in detail the issues listed below and in Paragraph 1.7 - Site Safety and Health Plan of this section. Significant aspects of the SSHP include:

- Site description and history
- Site map with hospital route
- Types of concentrations of site contamination
- Hazards of concern
- Waste characteristics
- Hazardous material summary
- Monitoring equipment
- Scope of construction work
- Work zones (exclusion zone, contamination reduction zone, support zone)
- Heat/cold stress monitoring
- Accident prevention
- Activity hazard analysis
- Confined space entry
- Air monitoring program
- Organizational structure indicating personnel responsibilities
- Hearing conservation program
- Spill and discharge control procedures
- Material handling and disposal
- Engineering safeguards

- Dust control plan
- Personal protective equipment (PPE) requirements and maintenance procedures
- Standard operating procedures and work guidelines
- Site control measures
- Personal hygiene
- Equipment and personnel decontamination procedures
- Emergency response and contingency procedures
- Emergency contacts
- Logs, reports, and recordkeeping
- Medical Surveillance Trailing
- Training

In addition to describing how exposure levels will be maintained below maximum permissible concentrations (OSHA, ACGIH, etc.) the SSHP will also address the health and safety hazards associated with each site task and operation to be performed during the remedial action. The following outlines anticipated tasks/operations:

- Mobilization
- Civil surveying
- Site preparation
- Clearing and grubbing
- Groundwater extraction well installation and testing
- Groundwater monitoring well installation
- Pipe trench and installation
- Groundwater treatment building construction
- Groundwater treatment system equipment installation
- Start-up and performance testing
- Groundwater and treatment plant sampling
- Operation and maintenance
- Site restoration
- Decontamination of personnel, tools, and equipment
- Demobilization

1.3.2 Weekly Safety and Accident Reports; Product Data; FIO

The Contractor shall submit the following documents to the Engineer during the course of the project site work:

- Weekly Safety Report (within one week)
- Accident Report (within 24 hours)

The accident report shall address the following items:

1. Name, organization, telephone number, and location of the Contractor
2. Name and title of the person(s) reporting.
3. Date and time of the accident/incident.
4. Location of the accident/incident, i.e., site location, facility name.
5. Brief summary of the accident/incident giving pertinent details including type of operation ongoing at the time of the accident/incident
6. Cause of the accident/incident, if known
7. Casualties (fatalities, disabling injuries).
8. Details of any existing chemical hazard or contamination.
9. Estimated property damage, if applicable.
10. Nature of damage, effect on contract schedule.
11. Action taken by Contractor to ensure safety and security.
12. Other damage or injuries sustained publicly or privately.

1.3.3 Air Monitoring Data; Product Data; FIO

The Contractor shall submit the Air Monitoring Data required by this section.

1.3.4 Personnel Health and Safety Certificates; Certificates; FIO

The Contractor shall submit the following information to the Engineer for approval at or prior to the Pre-Work Conference:

- Initial medical certifications and annual exam certificates for all field personnel
- Training certificates for all field personnel who have completed the safety and health course required by OSHA 29 CFR 1910.120
- Respirator fit-test certificates for all field personnel
- Confined Space Training
- Construction Safety

1.3.5 Safety and Health Manager Statements; Certificates; FIO

The Contractor shall submit the following information to the Engineer prior to mobilizing on site:

- An affidavit signed by the SHM indicating the Contractor's commitment to follow the SSHP
- A statement indicating that personnel who will enter the work zone understand that they are working on a hazardous waste site/operations and are trained and qualified in compliance with 29 CFR 1910.120(e)

1.3.6 Certificate of Worker/Visitor Acknowledgement; Certificates; FIO

The Contractor shall submit a Certificate of Worker/Visitor Acknowledgement for each worker or visitor on site in accordance with the requirements of this section.

1.3.7 Project Safety and Health Phase-Out Report; Closeout Submittals; FIO

The Project Safety and Health Summary Report shall be signed by the project SHM and submitted to the Engineer within 30 days of completing project site work. The report shall conform to the requirements of Paragraph 1.28 - Safety and Health Phase-out Report.

1.4 REGULATORY REQUIREMENTS

Work performed under this Contract shall comply with all applicable Federal, State, and local safety and occupational health laws and regulations. This includes, but is not limited to:

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION STANDARDS

29 CFR 1910	Section 120	"Hazardous Waste Operations and Emergency Response"
	Section 1000	"Air Contaminants"
	Section 38	"Emergency Action Plans"
	Section 95	"Occupational Noise Exposure"
	Sections 1001-1045	"Toxic and Hazardous Substances"
	Section 132	"General Requirements"
	Section 133	"Eye and Face Protection"
	Section 134	"Respiratory Protection"
	Section 135	"Head Protection"
	Section 136	"Occupational Foot Protection"
	Section 137	"Electrical Protective Equipment"
	Section 146	"Permit Required Confined Spaces"
	Section 147	"The Control of Hazardous Energy (lockout/tagout)"
	Subpart I	"Personal Protection Equipment"
29 CFR 1926	Section 65	"Hazardous Waste Operations and Emergency Response"
	Section 59	"Hazard Communication"
	Section 650-652	"Excavations"
	Subpart F	"Fire Protection and Prevention"
Title 10 CFR Part 19		"Notices, Instructions, and Reports to Workers: Inspections and Investigations."

Matters of interpretation of standards shall be submitted to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations and referenced documents vary, the most stringent requirements shall apply.

1.5 PRE-CONSTRUCTION SAFETY CONFERENCE

The Contractor shall be required to attend a Pre-Construction Safety Conference where information including, but not limited to, work procedures, safety considerations associated with those work procedures, heavy equipment to be used, training and experience to operate equipment, and safety interventions such as training and safety equipment will be provided.

1.6 SAFETY AND HEALTH PROGRAM

OSHA Standards 29 CFR 1910, Section 120 (b) and 29 CFR 1926, Section 65 (b) require employers to develop and implement a written Safety and Health Program for employees involved in hazardous waste operations. The site-specific program requirements of the OSHA Standards shall be integrated into one site-specific document, the SSHP. The SSHP shall interface with the employer's overall Safety and Health Program. Any portions of the overall Safety and Health Program that are referenced in the SSHP shall be included as appendices to the SSHP.

1.7 SITE SAFETY AND HEALTH PLAN

1.7.1 Preparation and Implementation

A SSHP shall be prepared covering onsite work to be performed by the Contractor and all subcontractors. The SHM shall be responsible for the development, implementation and oversight of the SSHP. The SSHP shall establish, in detail, the protocols necessary for the anticipation, recognition, evaluation, and control of hazards associated with each task performed.

1.7.2 Acceptance and Modifications

Prior to submittal, the SSHP shall be signed and dated by the SHM, and the Site Superintendent. The Engineer will review the SSHP and return it to the Contractor with comments. Deficiencies in the SSHP will be discussed at the Pre-Construction Safety Conference. The Contractor shall make all necessary amendments required by the Engineer and resubmit it for approval. This procedure shall continue until the Engineer gives final written approval. At that time, the Contractor shall indicate its commitment to following the SSHP by an affidavit, signed by the company SHM. The Contractor shall not mobilize onsite prior to receiving written approval of the SSHP.

Onsite work shall not begin until the plan has been approved and accepted by the Engineer. A copy of the written SSHP shall be maintained onsite and shall be made available in accordance with 29 CFR 1910, Section 120 (b) (1) (v) and 29 CFR 1926, Section 65 (b) (1) (v).1.8.4. As work proceeds, the SSHP shall be adapted to new situations and new conditions. Changes and modifications to the accepted SSHP shall be made with the knowledge and concurrence of the SHM, the Site Superintendent, and the Engineer. The requested modification may not be implemented until authorized in writing by the Engineer. Should any unforeseen hazard become evident during the performance of the work, the Site Safety and Health Officer (SSHO) shall bring such hazard to the attention of the SHM, the Site Superintendent, and the Engineer, both verbally and in writing, for resolution as soon as possible. In the interim, necessary action shall be taken to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted SSHP shall be cause for stopping of work until the matter has been rectified.

1.8 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

The SSHP shall include a site description and contamination characterization section that addresses the following elements:

- Description of site location, topography, size and past uses of the site.
- A list of contaminants that may present occupational safety and health hazards. This list shall be created by evaluating the analytical results in this section and by researching sources of information from past site investigation activities. Chemical names, concentrations ranges, affected media, locations onsite and estimated quantities/volumes to be impacted by site work shall be included if known. The contamination characterization shall be reviewed and revised if new chemicals are identified as work progresses.

Project site conditions are detailed in SECTION 01010 - SUMMARY OF WORK.

1.9 ACTIVITY HAZARD ANALYSIS

Prior to beginning each major phase of work, an Activity Hazard Analysis shall be prepared by the Contractor performing that work, and submitted for review and acceptance. A major phase of work is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform. The analysis shall define the activities to be performed and identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. Work shall not proceed on that phase until the activity hazard analysis has been accepted and a preparatory meeting has been conducted by the Contractor to discuss its contents with everyone engaged in the activities, including the government onsite representatives. The activity hazard analyses shall be continuously reviewed and, when appropriate, modified to address changing site conditions or operations, with the concurrence of the SHM, the Site Superintendent, and the Engineer. Activity Hazard Analyses shall be attached to and become a part of the SSHP. The Activity Hazard Analyses shall comply with 29 CFR 1910, Subpart I, "Personal Protective Equipment." The following elements, at a minimum, shall be addressed.

1.9.1 Site Tasks and Operations (Workplan)

Based on the type of remediation required, anticipated major site tasks and operations to be performed as described in Paragraph 1.3.1.

1.9.2 Hazards

The following potential hazards may be encountered during site work. This is not a complete list; therefore, the list shall be expanded and/or revised as necessary during preparation of the SSHP.

- Safety Hazards - Hazards including heavy equipment operation, contaminant handling, process equipment operations, slips, trips, and falls, etc.
- Chemical Hazards - Hazards involving chemical, physical and toxicological properties of contaminants sources and pathways of employee exposures.

- Physical Hazards - Hazards associated with noise and heat/cold stress.
- Biological Hazards - Hazards associated with poisonous plants, insects, and animals shall also be evaluated in the SSHP.
- Action Levels - Action levels shall be established for the active work areas in accordance with current EPA air quality guidelines (NAAQS). Minimum acceptable action levels for active work areas appear in Table 01351-1.

Table 01351-1
Minimum Acceptable Action Levels

Contaminant	Action Level
Total Dust	5 mg/m^3
Combustible Gas	>10% LEL
Oxygen	<19.5%
Oxygen	>23.5%
Total Organic Vapor	25 ppm

- Confined Space Entry - Entry into and work in a confined space will not be allowed when oxygen readings are less than 19.5 percent or greater than 23.5 percent or if the Lower Explosive Limit (LEL) reading is greater than 10 percent, unless these conditions are adequately addressed in the Confined Space Entry Program.

1.10 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

An organizational structure shall be developed that sets forth lines of authority, responsibilities, and communication procedures concerning site safety, health, and emergency response. The SSHP shall include a description of this organizational structure as well as qualifications and responsibilities of each of the following individuals. The Contractor shall obtain the Engineer's acceptance before replacing any member of the Safety and Health Staff.

The safety and health organization shall be separately identified from the project's operations organizations in order to maintain the appropriate degree of independence from day-to-day activities. The project manager shall be responsible for safety and health on the project including providing the proper and adequate personnel, materials, and resources to implement the safety and health program.

1.10.1 Site Superintendent

A Site Superintendent, who has responsibility to implement the SSHP, the authority to direct work performed under this contract and verify compliance, shall be designated.

1.10.2 Safety and Health Manager (SHM)

1.10.2.1 Qualifications

The services of a Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene shall be used. The name, qualifications (education summary and documentation), and work experience summary shall be included in the SSHP. The SHM shall have the following additional qualifications:

- A minimum of three years experience in developing and implementing safety and health programs at hazardous waste sites
- Documented experience in supervising professional and technician level personnel
- Documented experience in developing worker exposure assessment programs and air monitoring programs and techniques
- Documented experience in the development of PPE programs, including programs for working in and around potentially toxic, flammable and combustible atmospheres and confined spaces
- Working knowledge of state and federal occupational safety and health regulations

1.10.2.2 Responsibilities

The SHM shall:

- Be responsible for the development, implementation, oversight, and enforcement of the SSHP
- Sign and date the SSHP prior to submittal
- Conduct initial site-specific training
- Be present on site during the first three days of remedial activities and at the startup of each new major phase
- Visit the site as needed during construction activities, to audit the effectiveness of the SSHP
- Be available at all times for emergencies
- Provide consultation as needed to ensure the SSHP is fully implemented
- Coordinate any modifications to the SSHP with the Site Superintendent, the SSHO, and the Engineer
- Provide continued support for upgrading/downgrading the level of personal protection
- Be responsible for evaluating air monitoring data and recommending changes to engineering controls, work practices, and PPE
- Review accident reports and results of daily inspections
- Serve as a member of the Contractor's quality control staff

1.10.3 Site Safety and Health Officer (SSHO)

1.10.3.1 Qualifications

An individual and one alternate shall be designated the SSHO. The name, qualifications (education and training summary and documentation), and work experience of the SSHO and alternate shall be included in the SSHP. The SSHO shall have the following qualifications:

- A minimum of two years experience in implementing safety and health programs at hazardous waste sites where Level C PPE was required
- Documented experience in construction techniques and construction safety procedures.
- Working knowledge of federal and state occupational safety and health regulations
- Specific training in personal and respiratory protective equipment program implementation, confined space program oversight, and in the proper use of air monitoring instruments, and air sampling methods
- Certified as having completed training in First Aid and CPR by a recognized organization such as the American Red Cross

1.10.3.2 Responsibilities

The SSHO shall:

- Assist and represent the SHM in onsite training and the day-to-day onsite implementation and enforcement of the accepted SSHP. The SSHO shall report directly to the SHM.
- Have authority to ensure site compliance with specified safety and health requirements, Federal, State and OSHA regulations and all aspects of the SSHP including, but not limited to activity hazard analyses, air monitoring, use of PPE, decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the Emergency Response Plan (ERP), confined space entry procedures, spill containment program, and preparation of records by performing a daily safety and health inspection and documenting results on the Daily Safety Inspection Log.
- Have authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.
- Consult with and coordinate any modifications to the SSHP with, the SHM, the Site Superintendent, and the Engineer.
- Serve as a member of the Contractor's quality control staff on matters relating to safety and health.
- Conduct accident investigations and prepare accident reports.
- Review results of daily quality control inspections and document safety and health findings into the Daily Safety Inspection Log.
- In coordination with site management and the SHM, recommend corrective actions for identified deficiencies and oversee the corrective actions.

1.10.4 Occupational Physician or Licensed Health Care Provider (LHCP)

1.10.4.1 Qualifications

The services of a licensed physician or LHCP, who is certified in occupational medicine by the American Board of Preventative Medicine, or who, by necessary training and experience is Board eligible, shall be used. The physician or LHCP shall be familiar with this site's hazards and the scope of this project. The medical consultant's name, qualifications, and knowledge of the site's conditions and proposed activities shall be included in the SSHP.

1.10.4.2 Responsibilities

The physician or LHCP shall be responsible for the determination of medical surveillance protocols and for review of examination/test results performed in compliance with 29 CFR 1910, Section 120 (f) and 29 CFR 1926, Section 65 (f) and Paragraph 1.13 – Medical Surveillance.

1.10.5 Persons Certified in First Aid and CPR

At least one person who is currently certified in first aid and CPR by the American Red Cross or other approved agency shall be on site at all times during site operations. He/She shall be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens Standard of 29 CFR 1910, Section 1030. The person may perform other duties but shall be immediately available to render first aid when needed.

1.10.6 Safety and Health Technicians

For each work crew in the Exclusion Zone (EZ), one person, designated as a Safety and Health technician, shall perform activities such as air monitoring, decontamination, and safety oversight on behalf of the SSHO. They shall have appropriate training equivalent to the SSHO in each specific area for which they have responsibility and shall report to the SSHO.

1.11 TRAINING

All onsite Contractor personnel involved in intrusive work, or work that could expose them to site related contamination shall receive training in accordance with the Contractor's written safety and health training program and 29 CFR 1910, Section 120, 29 CFR 1926, Section 65, and 29 CFR 1926, Section 21. The SSHP shall include a section describing training requirements. Personnel not involved with intrusive work, such as pre-engineered building construction and treatment system assembly (prior to system operations) shall not require the above training.

1.11.1 General Hazardous Waste Operations Training

Personnel entering the EZ or Contamination Reduction Zone (CRZ) shall have successfully completed 40 hours of hazardous waste instruction off the site, three days actual field experience under the direct supervision of a trained, experienced supervisor, and eight hours refresher training annually. Onsite supervisors shall have completed the above training and eight hours of additional, specialized training covering at least the following topics: the employer's safety and health program, PPE program, spill containment program, and health hazard monitoring procedures and techniques. Copies of current training certification statements shall be submitted prior to initial entry onto the work site. The Contractor shall maintain, at the work site, documentation that shows that each onsite employee or subcontractor has completed the safety and health training course appropriate for their job function and responsibility. The training certificates shall be current within 12 months of the start of work and remain up-to-date during work performance.

1.11.2 Site-specific Training

The Contractor's SHM shall approve a site-specific training session for the Contractor and government personnel scheduled to work onsite. This training may be given by the SSHO. This site-specific training shall consist of an initial safety and health briefing on the following information:

- Names of personnel and alternate responsible for site safety and health
- Hazards present on the site
- Hazard communications training
- Safe use of engineering controls and equipment onsite
- Work practice by which the employee can minimize risks from hazards
- Selection, use, care, and maintenance of PPE
- Site control procedures, including log-in and log-out
- Confined space training (as needed)
- Site decontamination procedures
- Standard operating safety procedures
- Site emergency response contingency plan

1.11.2.1 Initial Session (Pre-entry Briefing)

Prior to commencement of onsite field activities, all site employees, including those assigned only to the Support Zone (SZ), shall attend a site-specific safety and health training session to ensure that all personnel are familiar with requirements and responsibilities for maintaining a safe and healthy work environment. Procedures and contents of the accepted SSHP shall be thoroughly discussed. The Engineer shall be notified at least five calendar days prior to the initial site-specific training session so government personnel involved in the project may attend.

1.11.2.2 Daily Sessions

Daily on-site training shall be conducted by the SSHO for personnel assigned to work at the site during the following day. The training shall address safety and health procedures, work practices, any changes in the SSHP, activity hazard analyses, work tasks, schedules, results of previous week's day monitoring, review of safety discrepancies and accidents.

All onsite personnel (Contractor, subcontractor(s), and government representatives) shall participate in the specified, periodic safety meetings. All affected personnel shall attend the special training. Training attendance and participation shall be documented in a training log. The SHM may delegate the day-to-day implementation of this follow-up training policy to the SSHO.

1.11.2.3 Training logs shall document personnel in attendance, topics covered and length of training for each type of training.

1.12 PERSONAL PROTECTIVE EQUIPMENT (PPE)

1.12.1 The Contractor's PPE Program shall comply with 29 CFR Part 1910.132, 29 CFR Part 1910.120, and 29 CFR Part 1910.136. Onsite personnel exposed to contaminants shall be provided with appropriate personnel protective equipment. Components of levels of protection (C, D and modifications) must be relevant to site-specific conditions, including heat and cold stress potential and safety hazards. Only respirators approved by NIOSH shall be used. Protective equipment and clothing shall be kept clean and well maintained. The PPE section of the SSHP shall include site-specific procedures to determine PPE program effectiveness and for onsite fit-testing of respirators, cleaning, maintenance, inspection, and storage of PPE.

1.12.2 Operations under this contract may require work exposure to potentially hazardous materials. The Contractor shall, therefore, provide and assure the wearing of all necessary PPE for all personnel on site. The SHM shall also establish action levels for upgrade or downgrade in levels of PPE. Protocols and the communication network for changing the level of protection shall be described in the SSHP. The PPE evaluation protocol shall address air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, individual medical considerations, etc.

1.12.3 Based on available information, the initial minimum protective equipment shall be Level D for each major task and operation. The minimum protective equipment for workers exposed to the site soils shall be Modified Level D. Available site information shall be reviewed and the list of tasks and operations and these levels of protection shall be expanded and/or revised during preparation of the SSHP.

1.12.4 Respiratory Protection

The Contractor's SHM shall establish in writing, and implement a respiratory protection program in accordance with 29 CFR 191.134, ANSI Z88.2.

1.12.5 PPE for Government Personnel

Five clean sets of PPE and clothing (excluding air-purifying negative-pressure respirators and safety shoes, which will be provided by individual visitors), as required for entry into the EZ and/or CRZ, shall be available at all times for use by the Engineer or official visitors. The items shall be cleaned and maintained by the Contractor and stored and clearly marked: "FOR USE BY GOVERNMENT ONLY." The Contractor shall provide basic training in the use and limitations of the PPE provided, and institute administrative controls to check prerequisites prior to issuance. Such prerequisites include meeting minimum training requirements for the work tasks to be performed and medical clearance for site hazards and respirator use. Visitors shall be responsible for adhering to the requirements of their Safety and Health Plan as well as the Contractor's Safety and Health Plan.

1.13 MEDICAL SURVEILLANCE

The SHM, in conjunction with the Occupational Physician or LHCP, shall detail, in the Contractor's Safety and Health Program and the SSHP, the medical surveillance program that includes scheduling of examinations, certification of fitness for duty, compliance with OSHA requirements, and information provided to the physician or LHCP. The Contractor shall use the service of a licensed physician board-certified or board-eligible in occupational medicine to provide a medical surveillance program as required by OSHA regulations. This would be without cost to the employee, without loss of pay and at a reasonable time and place. Selection of medical tests is the responsibility of the physician or LHCP, who shall certify that such medical surveillance meets the requirements of OSHA Standard 29 CFR 1910.120, and 29 CFR 1926, Section 65. The contents of the exam shall include wearing the PPE specified for the site. The protocol below is an example of requirements common in this industry. Final determination of tests should be made by the physician who performs the physical examination. The content of the medical examination shall be submitted to the Engineer and shall be relevant to the site conditions.

1.13.1 Frequency of Examinations

Employees shall have been provided with medical examinations as specified, within the last 12 months and shall receive exams annually thereafter (if contract duration exceeds one year); on termination of employment; reassignment in accordance with 29 CFR 1910, Section 120 (f)(3)(i)(C), and 29 CFR 1926, Section 65 (f)(3)(i)(C); if the employee develops signs or symptoms of illness related to workplace exposures; if the physician or LHCP determines examinations need to be conducted more often than once a year; and when an employee develops a lost time injury or illness during the period of this contract. The supervisor shall be provided with a written statement signed by the physician or LHCP prior to allowing the employee to return to the work site after injury or illness resulting in a lost workday, as defined in 29 CFR 1904, Section 12 (f).

Medical examinations must be repeated under the following conditions:

- At the discretion of the Contractor's Occupational Physician or LHCP, the Engineer, the SHM, or the SSHO

- At the request of an employee with demonstrated symptoms of exposure to toxic or hazardous materials
- Within 30 days of the completion of onsite work activities if the person is to leave the job site for periods greater than six months

Before work begins a copy of the physician's written opinion of fitness for work for each employee and ability to wear required respiratory protection shall be obtained and furnished to the SHM and the employee.

1.13.2 Medical Records

Documentation of medical exams shall be provided as part of the Certificate of Worker or Visitor Acknowledgment. Medical records shall be maintained in accordance with 29 CFR 1910, Section 120, and 29 CFR 1926, Section 65. The Contractor shall maintain all medical surveillance records for thirty years post employment and make these records available to the Engineer or other regulatory agencies, as required.

1.14 AIR MONITORING

1.14.1 The SSHP shall include the air monitoring procedures for occupational exposures. The air monitoring, at minimum, shall include procedures to detect combustible gases, volatile organic compounds (VOCs), dust and oxygen levels. The exposure monitoring plan shall be designed to detect and quantify the contaminants and physical agents that may be of concern during construction activities. The plan shall provide enough information to allow the SSHO to recognize conditions that require changes in work practices or level of protection.

1.14.2 During well installation, excavation, trenching, sampling, and operation and maintenance (involving chemical products or system leaks) activities, the Contractor shall furnish equipment for and perform real-time air monitoring to detect and quantify combustible gases, VOCs, dust and oxygen levels. All equipment shall be intrinsically safe. The Contractor shall perform real-time air monitoring for an adequate period prior to commencement of work to establish baseline conditions for total organic vapors, respirable particulates, explosive gases, and oxygen.

1.14.3 A data sheet shall be developed and implemented by the SHM upon which the following real-time monitoring data will be recorded:

- Date and time of monitoring
- Air monitoring location
- Instrument, model number, serial number
- Calibration/background levels
- Results of monitoring
- SSHO/Industrial Hygienist Technician signature
- Interpretation of the data and any further recommendations by the SHM or the SSHO in consultation with the SHM

The person conducting the monitoring must sign and date the data sheets as they are filled in. The SSHO, as appropriate, shall review then sign and date the data sheets weekly. These results shall be given verbally to the Engineer following each site scan for which concentrations exceed the action levels. This shall be documented in writing by the end of each work day with three copies provided to the Engineer.

1.14.4 Equipment used for air monitoring in accordance with this section shall be calibrated before and after each use and maintained as per specified methods, manufacturer's recommendations, and good industrial hygiene practices. The Contractor shall document, in the site log or site files, the regular calibration of each instrument used. Only individuals trained to operate this equipment shall do so.

1.14.5 The following publications define terms and establish contaminant evaluation and monitoring procedures discussed in this specification. These publications are incorporated into this specification by reference:

- Threshold Limit Values and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists (ACGIH) (current edition)
- Manual of Analytical Methods, 4th. Edition, Volumes 1 and 2, National Institute for Occupational Safety and Health (NIOSH)
- Industrial Hygiene Field Technical Manual, U. S. Department of Labor, Occupational Safety and Health Administration (OSHA)
- Air Contaminants - Permissible Exposure Levels, 29 CFR 1910.1000

1.14.6 When project operations involve intrusive activities such as the cutting of gas mains, fuel lines, or sewer lines, the Contractor shall use a combination of combustible gas indicator and oxygen monitor to monitor combustible gas and oxygen levels. When natural gas or sewer lines are involved the Contractor shall require the onsite presence of the utility company representative. All sources of ignition within 100 feet of any minor incident and 500 feet of any gas main shall be extinguished. Such monitoring shall be conducted close to the sources of potential leaks and in locations where leaked vapor could accumulate. If concentrations exceed the action levels, the Contractor shall stop work and ventilate the area. Any cutting or hot work done on fuel lines or storage tanks will be done in accordance with applicable API and OSHA standards.

1.15 HEAT AND COLD STRESS MONITORING

The SHM shall develop a heat stress and cold stress-monitoring program for onsite activities. Details of the monitoring program, including schedules for work and rest, and physiological monitoring requirements, shall be described in the SSHP. Personnel shall be trained to recognize the symptoms of heat and cold stress. The SSHO and an alternate person shall be designated, in writing, to be responsible for the heat and cold stress-monitoring program. Heat and cold stress monitoring program shall be in accordance with NIOSH/ACGIH recommended procedures.

1.16 SAFETY PROCEDURES, ENGINEERING CONTROLS, AND WORK PRACTICES

The SSHP shall describe the standard operating safety procedures, engineering controls and safe work practices to be implemented. These shall include, but not be limited to, the following:

- General site rules/prohibitions for personal hygiene
- Lock out/tag out procedures in accordance with 29 CFR 1910.147
- Work permit requirements including documenting utility clearances on a Field Safety Checklist. An example of this checklist is at the end of this section

- Material handling procedures to be followed in the handling, storage, and disposal of solids and/or liquids
- Spill and discharge control procedures including a description of prevention measures, such as building berms or dikes, spill control measures and material to be used (e.g., booms, vermiculite), location of the spill control material, PPE required to cleanup spills, disposal of contaminated material, and who is responsible to report the spill
- Drum and container handling procedures and precautions for the handling, storage, and disposal of encountered drums and containers
- Confined Space Entry procedures in compliance with 29 CFR 1910.146, "Permit Required Confined Spaces", if required
- Hearing conservation measures
- Illumination measures
- Sanitation measures including toilet and potable water facilities
- Fire Prevention
- Excavation, trenching, and well installation as described in Paragraph 1.17 - Excavation, Trenching, and Well Installation

1.17 EXCAVATION, TRENCHING, AND WELL INSTALLATION

1.17.1 The Contractor shall identify all buried utility lines within the work zones and take action to protect them before digging near them. The contractor shall perform a geophysical survey to locate potential underground structures and utilities.

1.17.2 The Contractor shall erect a visible barrier or fence at the edge of any open excavation and trench. Members of the general public shall be kept away from the excavation. Neither heavy equipment nor excavated material may be placed within two feet of an open excavation and trench. All mobile equipment shall be provided with working back-up alarms, brakes, and shut-off switches. Operators shall not leave their equipment while it is running.

1.17.3 For trenches, the Contractor shall comply with OSHA Confined Space Standards. The SSHO shall be required to approve the confined space entry procedures, with the assistance of the SHM.

1.17.4 Excavations/trenching shall comply with 29 CFR 1926 Subpart P and its appendices. The Contractor shall assure proper sloping, shoring, benching and other applicable standards defined in Subpart P. The Contractor shall employ a Registered Professional Engineer to inspect and approve shoring or sloping prior to placing an individual into a trench or other excavation requiring compliance with this standard.

1.18 SITE CONTROL MEASURES

To prevent the spread of contamination and control the flow of personnel, vehicles, and materials into and out of work areas, site control measures shall be established and described in the SSHP. The SSHP shall describe site control measures similar to those described in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*(NIOSH Pub No. 85-115).

1.18.1 Work Zones

Work zone boundaries (EZ, including restricted and regulated areas, CRZ, and SZ) and access points shall be established, and the boundary delineations shall be included in the SSHP. Delineation of work zone boundaries shall be based on the contamination characterization data and the hazard/risk analysis to be performed as described in Paragraph 1.9 - Activity Hazard Analysis. As work progresses and field conditions are monitored, work zone boundaries may be modified with approval of the Engineer. Work zones shall be clearly identified and marked in the field (using fences, tape, signs, etc.). A site map, showing work zone boundaries and locations of decontamination facilities, shall be posted in the onsite office. Work zones shall consist of the following:

Exclusion Zone (EZ): The EZ is the area where hazardous contamination is either known or expected to occur and the greatest potential for exposure exists. Entry into this area shall be controlled and exit may only be made through the CRZ.

Contamination Reduction Zone (CRZ): The CRZ is the transition area between the EZ and the SZ. The personnel and equipment decontamination areas shall be separate and unique areas located in the CRZ.

Support Zone (SZ): The SZ is defined as areas of the site, other than EZ and CRZ, where workers do not have the potential to be exposed to hazardous substances or dangerous conditions resulting from hazardous waste operations. The SZ shall be secured against active or passive contamination. Site offices, parking areas and other support facilities shall be located in the SZ.

1.18.2 Site Control Log

A log of personnel visiting, entering, or working on the site shall be maintained. The log shall include the following: date, name, agency or company, time entering and exiting site, time entering and exiting the EZ (if applicable), and PPE used. Before visitors are allowed to enter the CRZ or EZ, they shall show proof of current training, medical surveillance and respirator fit testing (if respirators are required for the tasks to be performed) and shall fill out the Certificate of Worker or Visitor Acknowledgment, an example of which is included at the end of this section. This visitor information, including date, shall be recorded in the log.

1.18.3 Communications

The SSHP shall identify the method by which Contractor personnel shall communicate in the event of an emergency. Communications with the office trailer, if it is outside vocal range, shall be by radio. Two-way radio communication shall be required during construction activity. Communications between Contractor and other organizations (e.g., the Engineer, or the emergency response provider) shall be over the telephone. The Engineer shall direct safety and health correspondence to the SHM through the Contractor's Project Manager. At a minimum, the following emergency telephone numbers must appear in the SSHP:

- Medical treatment facility and physician, including names and address
- Ambulance services
- Fire department
- Police department
- EPA Region 2

- EPA and NYSDEC spill Response
- Engineer
- National Response Center

1.18.4 Signs

The Contractor shall provide, install, and maintain signs and other warning devices to inform site personnel and members of the public of hazards present on the site in accordance with SECTION 01580 - SIGNS.

1.19 DECONTAMINATION

1.19.1 Personnel entering the EZ or CRZ or otherwise exposed or subject to exposure to hazardous chemical vapors, liquids, or contaminated solids shall adhere to the following personal hygiene and decontamination provisions. Decontamination shall be performed in the CRZ prior to entering the SZ from the EZ. Chapter 10.0 of NIOSH Pub No. 85-115 shall be consulted when preparing decontamination procedures.

1.19.2 Disposable PPE used in the work zone shall be removed and discarded into properly labeled PPE impermeable receptacles. Non-disposable PPE shall be washed with a low-sudsing detergent, rinsed with warm water, and then wiped dry with a disposable cloth. The Contractor shall evaluate the use of a qualified service to launder PPE. The decontamination wash water shall be treated onsite by a temporary treatment system in accordance with the site NYSDEC State Pollutant Discharge Elimination System Discharge (SPDES) permit equivalency or stored for treatment by the proposed groundwater treatment facility. Decontaminated PPE shall be stored in a secure area of the SZ.

1.19.3 Vehicles and equipment used in the EZ, and construction debris including concrete and stumps to be disposed of as clean materials shall be decontaminated in the CRZ prior to leaving the site. The procedures for decontamination of vehicles, equipment and construction debris shall be addressed in the SSHP. As a minimum, this shall include a high pressure wash area for equipment and vehicles and a steam cleaning system for use after the mud and/or site material has been cleaned from the equipment. At the decontamination pad, all visible contamination shall be removed with scrub brushes and high-pressure water sprays. Spray water from these washing procedures shall be treated by a temporary treatment system or stored and treated by the groundwater treatment system.

1.19.4 A decontamination station shall be provided within the CRZ for decontaminating vehicles and equipment leaving the EZ. The station shall be constructed to capture decontamination water, including overspray, and shall allow for collection and removal of the decontamination water using sumps, dikes and ditches as required.

1.19.5 Procedures for vehicles, equipment and construction debris decontamination shall be developed and used to prevent the spread of contamination into the SZ and offsite areas. These procedures shall address disposal of contaminated products and spent materials used on the site, including containers, fluids, oils, etc. Vehicles, equipment, and materials shall be decontaminated and inspected prior to leaving the site.

1.19.6 A special "clean area" shall be established for performing equipment maintenance. This area shall be used when personnel are required by normal practices to expose themselves to contact with soil, (i.e., crawling under a vehicle to change engine oil). All equipment shall be decontaminated by washdown in the CRZ prior to maintenance work. Maintenance such as greasing heavy equipment need not require decontamination unless the job requires body contact with soil.

1.19.7 Seats of equipment and vehicles used in the EZ shall not be cloth-covered. They shall be free from cracks or holes that would allow dust to enter seat padding or shall be covered with a temporary sheet vinyl covering.

1.20 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

The SSHP shall describe the emergency and first aid equipment to be available onsite. The following items, as a minimum, shall be maintained onsite and available for immediate use:

- First aid equipment and supplies approved by the consulting physician
- Emergency eyewashes and showers which comply with ANSI Z358.1
- Emergency-use respirators. For rescue purposes, two positive pressure self-contained breathing apparatus (SCBA) shall be supplied. These shall be dedicated for emergency use only and maintained on site in the CRZ.
- Fire extinguishers with a minimum rating of 20-A:120-B:C shall be provided at site facilities and in all vehicles and at any other site locations where flammable or combustible materials present a fire risk.
- Spill control materials and equipment that are sufficient to meet the requirements described in Paragraph 1.21- Spill and Discharge Control.

1.21 SPILL AND DISCHARGE CONTROL

1.21.1 The SSHP shall describe Spill and Discharge Control procedures including a description of prevention measures, such as building berms or dikes, spill control measures and material to be used (e.g., booms, vermiculite), location of the spill control material, PPE required to cleanup spills, disposal of contaminated material, and who is responsible to report the spill.

1.21.2 Storage of contaminated material or hazardous materials shall be appropriately bermed, diked and/or contained to prevent any spillage of material on uncontaminated soil. The Contractor shall respond to any spill of hazardous substances (as designated in 40 CFR 302), or pollutant or contaminant that is in custody or care of the Contractor, pursuant to this contract. Response shall be implemented within one hour, or as soon as practicable, following any accident or release of debris, as directed by the Engineer. Any direction from the Engineer concerning a spill or release shall not be considered a change under the contract. The Contractor shall comply with all applicable requirements of federal, state, or local laws or regulations regarding any spill incident.

1.21.3 If the spill or discharge is reportable, and/or human health or the environment is threatened, the National Response Center, the state, and the Engineer shall be notified as soon as possible. Notification of the accident shall include location of the accident, resultant damage or injury, person involved, probable cause, amount of waste spilled, and any other pertinent information concerning the accident.

1.22 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

An ERP that meets the requirements of 29 CFR 1910, Section 120 (l), and 29 CFR 1926, Section 65 (l), shall be developed and implemented as a section of the SSHP. This plan must present procedures the Contractor shall follow in the case of an injury or in case the Contractor observes an emergency unrelated to the field work. In the event of any emergency associated with the remedial action, the Contractor shall, without delay, alert all onsite employees that there is an emergency situation, take action to remove or otherwise minimize the cause of the emergency, alert the Engineer, and institute measures necessary to prevent repetition of the conditions or actions leading to, or resulting in, the emergency. Copies of the accepted SSHP and any revision shall be provided to the affected local emergency response agencies. The following elements, at a minimum, shall be addressed in the plan:

- Pre-Emergency Planning. The local emergency response agencies shall be contacted and met with during the preparation of the ERP, and the Contractor shall be required to conduct a site visit for the appropriate response agencies. The form at the end of this section entitled "Agreement for Emergency Response Services" shall be used by the Contractor to develop an individual agreement between the Contractor, a local emergency responder, and EPA.
- Acceptance letter of an Emergency Care Facility issued by SHM.
- Personnel roles, lines of authority, communications for emergencies and training.
- Emergency recognition and prevention.
- Site topography, layout, and prevailing weather conditions.
- Criteria and procedures for site evacuation.
- Specific procedures for decontamination and medical treatment of injured personnel.
- Route maps to nearest pre-notified medical facility.
- Emergency alerting and response procedures including posted instructions and a list of names and telephone numbers of emergency contacts (physician, nearby medical facility, fire and police departments, ambulance service, federal, state, and local environmental agencies as well as SHM, the Site Superintendent, the Engineer and/or their alternates).
- Criteria for initiating community alert program, contacts, and responsibilities.
- Procedures for reporting incidents to appropriate government agencies. In the event that an incident such as an explosion or fire, or a spill or release of toxic materials occurs during the course of the project, the appropriate government agencies shall be immediately notified. In addition, the Engineer shall be verbally notified immediately and receive a written notification within 24 hours.
- Procedures for critique of emergency responses and follow-up.
- Site security and control for incidents.
- Procedures for dealing with fires, explosives and spills.
- Procedures for decontaminating emergency response vehicles and equipment.

Contingency Planning Procedures and Contractor personnel responsibilities for potential emergencies shall be identified in the SSHP. Emphasis in the contingency planning section shall be placed on procedures. Contingency planning shall include situations that will involve mobilization of the surrounding community. A meeting with the local emergency preparedness agency shall be scheduled by the Contractor to discuss the contingency measures that shall be followed in the event of a major emergency that may affect offsite areas. A representative of the EPA, the Engineer or their representative, the Contractor and the SHM will all be required to attend. It shall be the responsibility of the Contractor to prepare an agenda and chair this meeting. This agenda shall be sent to all participating parties prior to the scheduled meeting. At this meeting, the Contractor shall present suggested guidelines and requirements for protecting local residents in the event of major fires and explosions and the offsite migration of releases from the site. Contingency procedures shall be confirmed by consensus agreement of the attending parties.

1.23 CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGMENT

A copy of a Contractor-generated certificate of worker/visitor acknowledgment shall be completed and submitted for each visitor allowed to enter CRZ or EZ, and for each employee, following the example certificate at the end of this section.

1.24 INSPECTIONS

The SSHO shall perform daily inspections of the job site and the work in progress to ensure compliance with the Safety and Health Program, the SSHP and other occupational health and safety requirements of the contract, and to determine the effectiveness of the SSHP. Procedures for correcting deficiencies (including actions, timetable and responsibilities) shall be described in the SSHP. Follow-up inspections to ensure correction of deficiencies shall be conducted and documented. Daily Safety Inspection Logs shall be used to document the inspections, noting safety and health deficiencies, deficiencies in the effectiveness of the SSHP, and corrective actions taken. The SSHO's Daily Safety Inspection Logs shall be attached to and submitted with the Daily Quality Control reports. Each entry shall include the date, work area checked, employees present in work area, PPE and work equipment being used in each area, special safety and health issues and notes, and signature of preparer. In the event of an accident, the Engineer shall be notified. Within two working days of any reportable accident, an Accident Report shall be completed and submitted to the Engineer. An Accident Report form shall be included in the SSHP.

1.25 DUST AND EMISSION CONTROL

Dust control shall be used throughout the work at the site and offsite. A proposed Dust Control Plan shall appear in the SSHP. The Dust Control Plan will identify materials, equipment, and methods to be used to control dust during project operations. The SSHO shall ensure that dust suppression practices are effective and being used. At a minimum, the following provisions shall be incorporated into the Dust Control Plan:

1.25.1 The Contractor shall implement dust control measures during all activities that may potentially generate airborne dust including, but not limited to, excavation, trenching, truck loading and transport. Visible, airborne dust shall be minimized at all times. The Contractor shall cease all dust generating activities when the wind speed, as measured by the onsite meteorological station, exceeds 15 mph for a sustained period of 15 minutes. Potential dust generating activities may resume based on the determination of the SSHO.

1.25.2 The Contractor shall use water as a dust-suppressing agent to prevent the creation and dispersion of dust. The Contractor shall avoid methods that generate slippery conditions or sticky mud.

1.25.3 Trucks in which the rubble and contaminated debris are carried shall be covered and sealed to control dust releases with a double, positive locking mechanism on the tailgates.

1.26 SEDIMENT CONTROL

The Soil Erosion and Sediment Control Plan will identify materials, equipment and methods to be used to control sediment during project operations, in accordance with the Contractor's approved Soil Erosion and Sediment Control Plan as detailed in SECTION 02370 – SOIL SURFACE EROSION CONTROL.

1.27 ACCIDENT PREVENTION PLAN

An Accident Prevention Plan shall appear in the SSHP. The Contractor and its subcontractor(s) shall follow the approved Accident Prevention Plan throughout construction. The Accident Prevention Plan shall include a phased safety plan for each of the major tasks performed under these specifications. The phased safety plans shall address the safety and health procedures, protective equipment, personnel, and training requirements that are special to each task. These major tasks are described in Paragraph 1.3.1. In the Accident Prevention Plan, particular attention shall be paid to excavations, medical and first aid sanitation, PPE, fire prevention, electrical safety, public safety, and chemical, physical and biological occupational exposure prevention. The Accident Prevention Plan shall address, at a minimum, the following items:

- Safety Meetings
- Fire Prevention and Protection
- Site Housekeeping
- Mechanical Equipment Inspection
- Sanitation
- Daily Safety Inspections
- Accident Reporting
- Safety Equipment
- Medical Support
- Personal Protective Equipment
- Accident Prevention Signs and Signals
- Mandatory Site-specific Training
- Emergency Response Training
- Attendance

1.28 SAFETY AND HEALTH PHASE-OUT REPORT

A Safety and Health Phase-Out Report shall be submitted within 10 working days following completion of the work, prior to final acceptance of the work. The following minimum information shall be included:

- Summary of the overall performance of safety and health (accidents or incidents including near misses, unusual events, lessons learned, etc.)
- Final decontamination documentation including procedures and techniques used to decontaminate equipment, vehicles, and onsite facilities
- Summary of exposure monitoring and air sampling accomplished during the project

- Signatures of SHM and SSHO
- Copies of hazardous waste manifest forms indicating proper disposal of hazardous wastes was accomplished
- Initial and final physical/medical certifications
- Daily Safety Inspection Reports
- Weekly Safety Reports
- Training Logs
- Accident Reports

PART 2 (NOT USED)

PART 3 (NOT USED)

EXAMPLE CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGMENT

PROJECT NAME:
CONTRACT NO.:
PROJECT ADDRESS:
CONTRACTOR'S NAME:
EMPLOYEE'S NAME:

The contract for the above project requires the following: that you be provided with and complete formal and site-specific training, that you be supplied with proper personal protective equipment including respirators, that you be trained in its use, and that you receive a medical examination to evaluate your physical capacity to perform your assigned work tasks, under the environmental conditions expected, while wearing the required personal protective equipment. These things are to be done at no cost to you. By signing this certification, you are acknowledging that your employer has met these obligations to you.

I HAVE READ, UNDERSTAND AND AGREE TO FOLLOW THE SITE SAFETY AND HEALTH PLAN FOR THIS SITE.

Name: ______________________________ Date:

FORMAL TRAINING: I have completed the following formal training courses that meet OSHA's requirements:

Date Completed
40 hour: .... ____________
8 hour supervisory: .... ____________
8 hour refresher: .... ____________

SITE-SPECIFIC TRAINING: I have been provided and have completed the site-specific training required by this contract. The Site Safety and Health Officer conducted the training.

RESPIRATORY PROTECTION: I have been trained in accordance with the criteria in the Contractor's Respiratory Protection program. I have been trained in the proper work procedures and use and limitations of the respirator(s) I will wear. I have been trained in and will abide by the facial hair policy.

RESPIRATOR FIT-TEST TRAINING: I have been trained in the proper selection, fit, use, care, cleaning, and maintenance, and storage of the respirator(s) that I will wear. I have been fit-tested in accordance with the criteria in the Contractor's Respiratory Program and have received a satisfactory fit. I have been assigned my individual respirator. I have been taught how to properly perform positive and negative pressure fit-check upon donning negative pressure respirators each time.

MEDICAL EXAMINATION: I have had a medical examination within the last twelve months, which was paid for by my employer. The examination included health history, pulmonary function tests, and may have included an evaluation of a chest x-ray. A physician made determination regarding my physical capacity to perform work tasks on the project while wearing protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination. My employer's industrial hygienist evaluated the medical certification provided by the physician and checked the appropriate blank below. The physician determined that there:

__________were no limitations to performing the required work tasks.

__________were identified physical limitations to performing the required work tasks.

Date medical exam completed: ______________________________

Employee's Signature: ______________________________

Date: ______________________________

Printed Name: ______________________________

Social Security Number: ______________________________

Contractor's Site Safety and Health Officer Signature: ______________________________

Date: ______________________________

Printed Name: ______________________________

Social Security Number: ______________________________

FIELD SAFETY CHECKLIST

Work Location: ______________________________

1. Reviewed work plans with project engineer. ______________________
(initial/date)

2. Requested maps of aboveground and underground utilities.
____
(initial/date)

3. Reviewed utility maps: ______________________
(initial/date)

(water supply, firewater, sewer, process sewer, electric, gas, telephone, other underground utilities)

4. Met with utilities representative to review utility locations and asked each representative the following questions: ______________________
(initial/date)

a. Any underground utilities at work site location?
b. Any ongoing construction that would affect field activities?
c. Any chemical releases associated with utilities?
d. Any other hazards associated with utilities?
e. Any special requirements?

Name of utilities and their representatives:

Utility Company	Representative

FIELD SAFETY CHECKLIST (CONT'D)

5. Determined if any permits are required: ______________________
(initial/date)

Type(s): ______________________________________

6. Obtained necessary permits: ______________________
(yes or no)

Permit Expiration date(s): ______________________

7. Requested MSDS for any known or expected onsite chemical:

____
(initial/date)

8. Client's established protocol, if any: ______________________

____

____

____

____

9. Obtained final approval for commencement of work: ______________________

____

____

Comments:

DRILLING, TRENCHING/EXCAVATION SAFETY SIGNOFF SHEET
(TO BE COMPLETED BEFORE DRILLING, TRENCHING/EXCAVATION COMMENCES)

Field location of monitoring well/boring/trenching/excavation ____________ has been evaluated for clearance of underground utilities (i.e., electrical, sewers, firewater, and other piping) as well as 10-foot clearance from overhead power lines. Additionally, clearance has been received from client, property owner, and other affected parties.

In addition, the Contractor Site Safety Supervisor and the drilling/excavation foreman have familiarized themselves with the site's safety and special considerations:

	Printed Name	Signature
Project Engineer		
Excavation Foreman		
Drilling Contractor		
City Engineer		
Gas & Water		
Electric		
Telephone		
TV Cable		

Note: Drilling, Trenching/Excavation will commence after all affected parties have signed off.

UTILITY CLEARANCE FOR FIELD ACTIVITIES

Action: All utilities for the site are to be cleared by the appropriate parties prior to initiating any intrusive activity.

Utilities: Power lines and electrical duct banks, telephone lines, light circuits, data lines, cable television lines, fiber optic lines, fire water pipes, potable water pipes, industrial water supply pipes, sewers, drainage pipes, storage tank piping and ventilation pipes, steam pipes, natural gas pipelines, vaults, sump pits, etc.

Where: Every location where intrusive work is scheduled.

Who: Any person having responsibility for the intrusive work or who participates in the intrusive work, and the property owner and utility representatives.

When: Before work in the target area begins.

How: Contact "ONE CALL" agencies, property owner information, tools, eyes, and common sense. Perform a geophysical survey. Make records based on a "MEET" or a "LOCATE."

Why: The minimum effort needed to protect life and property, and there is no excuse not to.

Contacts: New York City and Long Island "One Call" System - 1 -800-272-4480

Applications:

Gas Stations
Refineries
Power Plants
Factories
Wall and Ceiling Installation
Abandoned Warehouses
Vacant City Block

Attachment to Emergency Response Plan

AGREEMENT FOR EMERGENCY RESPONSE SERVICES

This agreement certifies:

That the Department (local HAZMAT team, fire fighting, police, emergency medical responder, health care providers, etc., organization responding at the site) received and reviewed the Emergency Response Plan for the Old Roosevelt Field Superfund Site, located in Nassau County, New York.

That on [date], the representative from the [Department] participated in an onsite visit (or conducted a meeting, depending on the organization). During the visit, [Prime Contractor] explained the details of the site's Emergency Response Plan including, but not limited to, roads and evacuation routes, properties of hazardous materials handled at the site, locations where site personnel would normally be working [add any other special provision], and expectations for emergency response support.

The [Prime Contractor] will notify in writing the [Department and EPA] of any amendment or significant change in the Emergency Response Plan.
If applicable:

That the U. S. Environmental Protection Agency (EPA) Region II provided (or will provide) the following:

- Description of any site-specific training.
- Description of equipment and serial numbers, with their specific location.

  The above mentioned equipment will be fully available to the [Department] for training and familiarization, but will remain EPA's property in accordance with SARA Title I Section 123 (b)(2).

- Location of information repository
- Reference material to be kept onsite

That through the above mentioned provisions the [Department] agrees to provide [service] in the event of an emergency or threat of an emergency at the _________site. This agreement will remain in effect for the duration of [Prime Contractor] contract or until 90 days after written notice is given by either party justifying cancellation.

Department	Prime Contractor
EPA (concurrence)	EPA's Contracting Party (concurrence)

END OF SECTION

SECTION 01355

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

This section covers the requirements for protection of the human and natural environment during demolition, soil excavation, and site restoration. This includes furnishing all labor, materials, equipment and incidentals required to provide environmental pollution and damage control.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent reference. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

33 CFR 328	Definitions of Waters of the United States
40 CFR 279	Standards for the Management of Used Oil
40 CFR 302	Designation, Reportable Quantities, and Notification

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Environmental Protection Plan; Pre-Construction Submittals; EA

An Environmental Protection Plan shall be submitted for review and approval within 21 calendar days prior to Pre-Work Conference. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Engineer for the purpose of discussing the implementation of the revisions to the plan including any reporting requirements, and methods for administration of the Contractor's Environmental Protection Plan. The Environmental Protection Plan shall be current and maintained on site by the Contractor. The Environmental Protection Plan shall include, but shall not be limited to, the following:

1.3.1.1 Name of person within the Contractor's organization who will be responsible for ensuring adherence to the Environmental Protection Plan.

1.3.1.2 Name and qualifications of person responsible for manifesting hazardous waste to be removed from the site.

1.3.1.3 Name and qualifications of person responsible for training the Contractor's environmental protection personnel.

1.3.1.4 Description of the Contractor's environmental protection personnel training program.

1.3.1.5 A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction.

1.3.1.6 A contaminant prevention plan that identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with federal, state, and local laws and regulations for storage and handling of these materials. A copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.

1.3.1.7 Appendix

Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents shall be attached, as an appendix, to the Environmental Protection Plan.

1.4 DEFINITIONS

1.4.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.4.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste.

1.4.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners, excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.4.4 Surface Discharge

The "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.4.5 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.5 GENERAL REQUIREMENTS

1.5.1 The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract.

1.5.2 The Environmental Protection Plan shall not be construed as relieving the Contractor of any applicable federal, state, and local environmental protection laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations. During construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.6 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.7 PROTECTION FEATURES

Prior to start of any onsite construction activities, the Contractor and the Engineer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection. This survey report shall be submitted to for approval. The Contractor shall protect those environmental features included in the survey report regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.8 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the Contract Documents which may have an environmental impact will be subject to approval by the Engineer and may require an extended review, processing, and approval time. The Engineer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Engineer determines that the proposed alternate method will have an adverse environmental impact.

1.9 NOTIFICATION

The Engineer will notify the Contractor in writing of any observed noncompliance with federal, state or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection Plan. The Contractor shall, after receipt of such notice, inform the Engineer of the proposed corrective action and take such action when approved by the Engineer. The Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Engineer may take under the contract, or in accordance with the federal acquisition regulation or federal law.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

The Contractor shall be responsible for obtaining and complying with all environmental permits and commitments required by federal, state, regional, and local environmental laws and regulations.

3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the Contract Documents. Prior to the beginning of any construction activity, the contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the Contract Drawings or specified to be cleared, the Contractor shall not remove, cut, deface, insure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

3.2.1 Work Area Limits

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area, which are not to be disturbed, shall be marked or fenced. Monuments and markers shall be protected before construction operation commences.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas and stockpile storage areas shall be placed in areas designated on the Contract Drawings or as directed by the Engineer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for disturbed earthen areas to prevent sediment from entering nearby water. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and groundwater. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by state or federally issued clean water act permits.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all federal and state air emission, and performance laws and standards.

3.4.1 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the State of New York and local rules.

3.4.2 Burning

Burning shall be prohibited on the project site.

3.5 AIR EMISSION CONTROL

The Contractor shall implement the air-monitoring program in accordance with Contractor's approved Health and Safety Plan.

3.6 WASTE HANDLING, STORAGE AND DISPOSAL

3.6.1 Solid Wastes

Handling, storage and disposal of solid waste shall be performed in accordance with SECTON 02120 - OFFSITE TRANSPORATATION AND DISPOSAL.

3.6.2 Chemicals and Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with federal, state, and local laws and regulations.

3.6.3 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all federal, state, regional and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, state, and local laws and regulations.

3.6.4 Wastewater

3.6.4.1 Wastewater from construction activities, such as concrete curing, foundation and concrete clean up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction-related wastewater in accordance with all federal, state and local laws and regulations.

3.6.4.2 Groundwater shall be containerized and treated onsite prior to being discharged in accordance with all federal, state, and local laws and regulations.

3.6.4.3 Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing shall be disposed of in accordance with all federal, state and local laws and regulation.

3.7 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The contractor shall ensure that the equipment is free from soil residuals, noxious weeds, and plant seeds.

3.8 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for the length of time construction activities creates the particular pollutant.

3.9 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: method of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative cover, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemical or wastes, and other regulated contaminants; and endangered species and their habitat that are known to be in the area.

3.10 POST CONSTRUCTION CLEANUP

The Contractor shall clean up and restore all areas used for construction. The Contractor shall, unless otherwise instructed in writing by the Engineer, obliterate all signs of temporary construction facilities such as work areas, storage areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area paved or seeded unless otherwise indicated.

END OF SECTION

SECTION 01380

PROJECT PHOTOGRAPHS

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall furnish all labor, equipment, materials, and incidentals required to provide photographic documentation of construction activities.

1.2 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The Contractor shall submit the following items in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

1.2.1 Project Photographs; Product Data; FIO

The Contractor shall submit project photographs as specified in Paragraph 3.2 - ELECTRONIC FILES FOR DIGITIAL PHOTOGRAPHS. The Contractor shall also include photocopies of the logbook documentation as specified in Paragraph 3.3 - LOGBOOK DOCUMENTATION OF DIGITAL PHOTOGRAPHS.

PART 2 PRODUCTS

2.1 DIGITAL CAMERA

The Contractor shall use a digital camera to produce project photographs. The digital camera shall be capable of transferring digital photographs to a "JPEG" or "TIFF" electronic file format. The digital camera shall produce pictures of 4.0 megapixel (2,240 x 1,680 resolution) or better with 48 Bit Color Depth.

2.2 PHOTOGRAPHIC LOGBOOK

The Contractor shall keep all written documentation concerning project photographs in a photographic logbook. The logbook shall be constructed of water-resistant paper and bound along the left edge.

PART 3 EXECUTION

3.1 PROJECT PHOTOGRAPHS

3.1.1 The Contractor shall furnish digital photographs in an electronic file format approved by the Engineer, taken with a digital camera by an experienced photographer using suitable equipment, to record the important features of the site prior to the commencement of work, during construction, and after the work has been completed.

3.1.2 Before work begins, the Contractor shall take digital photographs of the proposed temporary facilities, extraction and monitoring well locations, access road, treatment facilities, and trenching areas depicting the existing conditions.

3.1.3 Progress Photographs: After construction operations have been started at the site, the Contractor shall photographically record the project. Each progress photograph shall be a separate electronic file and shall include coverage of:

- Sediment and Erosion Control Measures
- Extraction and Monitoring Well Drilling/Installation
- Excavation, trenching and backfilling
- Well development and step testing
- Pilot testing for iron removal system
- Treatment Building (interior/exterior)
- Treatment Equipment
- Piping Installation
- Start Up Operations
- Sampling
- Site Restoration
- Unanticipated Events or Accidents

In addition, at each successive period of photography, at least one digital photograph from the same reference point shall be taken.

3.1.4 The actual number and location of views of progress photographs to be taken will be as directed by the Engineer; however, it is anticipated that approximately 200 project photographs will be required.

3.1.5 After completion of work, the Contractor shall take a minimum of 50 digital photographs of the site. The locations shall be designated by the Engineer and shall be similar to the photographs showing the site condition prior to commencement of construction activities.

3.2 ELECTRONIC FILES FOR DIGITAL PHOTOGRAPHS

3.2.1 At a minimum, the Contractor shall download digital photographs from the digital camera to a personal computer daily during photographic sessions for transfer to an electronic file format. The electronic file shall be either "JPEG" or "TIFF" format.

3.2.2 The Contractor shall rename each downloaded electronic file at the time of download with a distinct filename that corresponds to the photographic logbook specified in Paragraph 3.3. The filename shall have the following format as defined below:

yyyy-mm-dd_hhnn_xxx

- "yyyy" is the year the photograph was taken.
- "mm" is the month the photograph was taken.
- "dd" is the day the photograph was taken.
- "hh" is the hour the photograph was taken using military time nomenclature.
- "nn" is the minute the photograph was taken using military time nomenclature.
- "xxx" is a three digit sequential number starting with 001 for each photograph taken during the preceding time period.

3.2.2.1 An example of the above filename format is 2008-12-15_1845_002. This example photograph filename would have been the second photo taken at 6:45 p.m. on December 15, 2008.

3.2.3 The Contractor shall copy the electronic files to a compact disc after renaming as described in Paragraph 3.2.2 is completed. The compact disc shall be a "CD-R" or "CD-RW" format.

3.2.3.1 The copy process shall be completed the same day the photographs are downloaded, except as approved by the Engineer.

3.2.3.2 If the Engineer allows the copy process to be delayed, the Contractor shall backup the electronic files on at least one storage device other than the hard drive of the personal computer storing the electronic files until the copy process is completed.

3.2.4 The Contractor shall submit compact discs containing electronic files of digital photographs a minimum of once monthly.

3.2.5 All digital photographs and related electronic files are U. S. Government property and shall not be released by the Contractor to the public or news media.

3.3 LOGBOOK DOCUMENTATION OF DIGITAL PHOTOGRAPHS

3.3.1 The Contractor shall record pertinent information concerning digital photographs in a photographic logbook as specified in Paragraph 2.2. Writing shall be done in a waterproof ink.

3.3.2 The following information shall be recorded on the front cover of the logbook:

- Project name
- Contract number
- Contractor name

3.3.3 The following information shall be included for each photographic entry, at a minimum:

- Date
- Time
- Photograph filename
- Location
- Direction
- Description

3.4 VIEWS REQUIRED

3.4.1 Prints shall illustrate condition and location of work and the state of progress.

3.4.2 At successive periods of photography, the Contractor shall take at least one photograph from the same reference point as previously required.

3.4.3 The Contractor shall consult with the Engineer at each period of photography for recommendations concerning views required.

END OF SECTION

SECTION 01450

CHEMICAL DATA QUALITY CONTROL

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This section covers requirements for the Contractor's Chemical Data Quality Control for Remedial Action (RA) of contaminated sites. This section is to be used to prepare a Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) that shall contain the necessary technical detail and directions for all sampling and field measurements and specifies all quality assurance (QA) and quality control (QC) procedures required for planning, implementation and assessment of the RA and Operation and Maintenance (O&M) period.

1.1.2 The field measurements and samples shall be collected by the Contractor during the Initial Testing Program (ITP), step and yield testing, O&M period, and Baseline and Site-Wide Groundwater Monitoring Program.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

<u>DEPARTMENT OF TRANSPORTATION (DOT)</u>

40 CFR 261	Identification and Listing of Hazardous Wastes, Parts 106 to 179

<u>ENVIRONMENTAL PROTECTION AGENCY (EPA)</u>

EPA 450/4-89-015	Data Quality Objectives for Ambient Air Monitoring Around Superfund Sites (Stages I and II)
EPA 450/4-89-005	Data Quality Objectives for Ambient Air Monitoring Around Superfund Sites (Stage III)
EPA 540/R 94-013	Contract Laboratory Program National Functional Guidelines for Inorganic Data Review or other EPA validation statement of work as applicable to the method
EPA 540/R 99-008	Contract Laboratory Program National Functional Guidelines for Organic Data Review or other EPA validation statement of work as applicable to the method
EPA 540/R-07/06	Contract Laboratory Program Guidance for Field Samplers, July 2007

EPA Region II/SOP HW-2	SOPs for Evaluation of Metals Data for the CLP, Revision 13, September 2006
EPA Region II/SOPs HW-33, 34, 35, 36, and 37	SOPs for CLP Organics Data Review and Preliminary Review,SOM01.2 for evaluating VOC, Trace VOC, SVOC, Pesticide, and PCBs (Aroclors), (Revision 1) August 2007
EPA Region II/SOP HW-32	Policy for Implementing the National Strategy for Procuring Analytical Services for all OSWER Programs SOP. Revision 6, December 2006.
EPA QA/G-5	Guidance for Quality Assurance Project Plans, EPA/240/R-02/009
EPA QA/R-5	EPA Requirements for Quality Assurance Project Plans, EPA/240/B-01/003
EPA 540/P-87/001B	A Compendium of Superfund Field Operation Methods
EPA 540/R-93-071	Guidance on Systematic Planning using the Data Quality Objectives Process, February 2006
EPA SW-846	(Rev 0; updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol. IA, IB, IC, and II)
EPA 505-B-04-900A	Intergovernmental Data Quality Task Force (IDQTF), Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) Part 1 - Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, March 2005
EPA 505-B-04-900B	Intergovernmental Data Quality Task Force (IDQTF), Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) Part 2B – Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities, March 2005
EPA 505-B-04-900C	Intergovernmental Data Quality Task Force (IDQTF), Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) Part 2A – Workbook for UFP for QAPP, March 2005

1.3 SUBMITTALS

The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP); Pre-Construction Submittals; EA

The UFP-QAPP shall be submitted to the Engineer at least 21 calendar days prior to Pre-Work Conference meeting for approval in accordance with Paragraph 3.3.

1.3.2 ANSETS Data Requirement Form and Trip Report; Test Reports; FIO

The Contractor shall submit an Analytical Services Tracking System (ANSETS) Data Requirement Form and Trip Report in accordance with Paragraph 1.6.3.

1.3.3 Topsoil Material Testing Results; Test Reports; EA

The Contractor shall submit topsoil sample results to the Engineer for approval prior to use of such sources.

1.3.4 Analytical Data; Test Reports; EA

Hard copy and electronic copy of all the analytical data collected at the site shall be submitted to the Engineer in accordance with Paragraph 1.7.

1.3.5 Non-Conformance Reports; Test Reports; FIO

Reports shall be submitted within 48-hours of the occurrence of any significant problem with sampling, analytical procedures, instrument calibration and maintenance, and project quality control. Significant problems shall include, without limitation, the items specified herein as requiring corrective actions by the Contractor.

1.3.6 Chemical Data Final Report (CDFR); Test Reports; EA

The CDFR as described in Paragraph 3.5 shall be submitted to the Engineer within 30 calendar days of completing work at the site and before final payment. Each report shall be labeled with the contract number, project name, and location.

1.4 ACRONYMS

The definition of acronyms used by the Contractor that pertain to chemical data quality control shall be clearly defined for all contract related products and communications.

1.5 CHEMISTRY REQUIREMENTS

Chemical data shall be acquired, documented, verified and reported in a manner that assures that the precision, accuracy, and completeness requirements are achieved, as specified in the Contractors approved UFP-QAPP. The Contractor must demonstrate the analytical chemistry method's ability to meet the project data quality objectives (DQOs). Where national standard methods are not available for the medium, methods published by reputable technical organizations (e.g., American Society for Testing and Materials (ASTM)) shall be utilized. Sampling, analysis and measurement requirements listed in the following subsections shall be included in the UFP-QAPP.

1.5.1 Data Quality Objectives (DQO)

1.5.1.1 Samples shall be acquired, and chemical parameter measurements shall be performed in such a manner that the resulting data meets and supports data use requirements. Data for groundwater samples acquired during Baseline and Site-Wide Monitoring program and process samples (if validation is required by site permit equivalencies), shall be of definitive quality.

Definitive quality data shall be acquired, documented, verified and reported to ensure that the specified data quality indicators (DQIs) (precision, accuracy, representativeness, comparability, completeness and sensitivity) measurement performance criteria are achieved. Data for process sampling that does not require data validation for the permit equivalencies, disposal sampling, process monitoring, and health and safety monitoring shall be of screening quality. These data are used to identify the presence of a target compound or group of compounds, without actually identifying or quantifying the specific compound(s).

1.5.1.2 Groundwater Sampling

1.5.1.2.1 Extraction Well

Groundwater samples from extraction well shall be collected and analyzed during step and yield tests to determine the need for iron removal system and to verify the influent concentrations for Volatile Organic Compounds (VOCs) in accordance with SECTION 02525 - WELL INSTALLATION. The extraction well samples shall be analyzed with quick turnaround time of 3 working days.

1.5.1.2.2 Baseline and Site-Wide

Groundwater samples shall be analyzed, and water quality measurements shall be performed to assess remedial performance and progress over time. Baseline (prior to treatment plant startup) and quarterly groundwater monitoring sampling events shall be conducted in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE for a period of one year.

1.5.1.3 Process Sampling

Process sampling shall be conducted in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE.

1.5.1.3.1 Influent, intermediate and effluent process water samples shall be analyzed to monitor treatment plant performance and refine operating conditions, when necessary, to optimize performance. The Contractor shall collect and analyze the samples during the ITP and for a period of one year. Samples collected during the ITP shall be analyzed with a quick turnaround time of 24 hours.

1.5.1.3.2 Influent and effluent samples (water) shall be analyzed in accordance with New York State Pollution Discharge Elimination System (SPDES) permit equivalency requirements. The sampling objectives to be contained in the Contractor's UFP-QAPP shall include effluent limits for all compounds required under NYSDEC SPDES permit equivalent.

1.5.1.4 Topsoil Sampling

1.5.1.4.1 Topsoil material samples shall be collected and analyzed in accordance with SECTION 02300 - EARTHWORK. At minimum, the sample shall be analyzed for total organic content, pH and nutrients (nitrogen, phosphate, and potassium).

1.5.1.4.2 Analytical sampling results for topsoil shall be submitted to the Engineer for approval prior to use. Sample data shall be sufficient to demonstrate that topsoil materials meet the NYSDOTSS Section 713 requirements.

1.5.1.5 Waste Disposal Characterization Sampling

Waste disposal characterization samples shall be collected and analyzed in accordance with disposal facilities requirements.

Standard analytical requirements for waste disposal characterization samples are listed below:

a. Paint filter liquid test
b. Corrosivity
c. Ignitability
d. Reactivity- Cyanide
e. Reactivity- Sulfide
f. TCLP - Metals
g. TCLP - Volatile Organic Compounds (VOCs)
h. TCLP - Semi Volatile Organic Compounds (SVOCs)
i. TCLP - Pesticides
j. TCLP – Herbicides
k. Moisture Content

1.5.1.6 Air Monitoring

1.5.1.6.1 The Contractor shall conduct off gas system monitoring in accordance with SECTION 01800 – TREATMENT SYSTEM OPERATION AND MAINTENANCE and SECTION 13300 – GROUNDWATER TREATMENT SYSTEM.

1.5.1.6.2 The Contractor shall conduct air monitoring throughout the project. Air monitoring shall be performed as outlined in SECTION 01351 - SAFETY, HEALTH AND EMERGENCY RESPONSE and in accordance with Contractor's approved Environmental Monitoring Program (EMP). The Contractor shall be required to monitor the air for OSHA requirements, for the protection of its workers, for offsite migration of pollutants and nuisance dust, and for protection of the surrounding community.

1.6 QUALITY ASSURANCE (QA)/QUALITY CONTROL (QC) ELEMENTS

The Contractor shall be responsible for the following QA/QC elements necessary to monitor and ensure the quality of chemical data produced.

1.6.1 Analytical Testing Laboratories

1.6.1.1 General

1.6.1.1.1 The Contractor shall comply with the Superfund Field and Analytical Services Teaming Advisory Committee (FASTAC) policy as detailed in SOP HW-32, Revision 6 in selecting and implementing analytical services for this project. This policy requires use of the tiered decision tree for procuring Superfund analytical services for all non-time critical data collection projects. The decision tree is as follows:

Tier 1: EPA Region II Division of Environmental Science and Assessment (DESA) Laboratory including Environmental Services Assessment Team (ESAT) support
Tier 2: National analytical Services Contract Laboratories Program (CLP)
Tier 3: Region Specific Analytical Services (SAS) Contract laboratories
Tier 4: Contractor, Interagency Agreement (IAGs) and Field Contractor Subcontract laboratories

1.6.1.1.2 The Contractor shall propose the analytical subcontract laboratories in the UFP-QAPP for the analytical services that cannot be accommodated through the DESA and/or CLP flex clause to achieve the required sample analyses for the project. The use of subcontract laboratories shall be approved by the EPA Regional Project Manager (RPM) and Regional Sample Control Center (RSCC). The Contractor shall provide justification for use of subcontractor laboratory to EPA Regional Project Manager (RPM) along with the laboratory booking forms indicating the required analyses, turn-round-times, special requests, etc. The subcontract laboratory shall meet the certification requirements listed in Paragraph 1.6.1.3.

1.6.1.2 Subcontracted Laboratory Analytical Requirements

The Contractor shall provide chemical analyses specified in this Contract either by the Contractor's and or by subcontractor's laboratory. The Contractor shall provide chemical analyses for all parameters by methods specified in the project specification or UFP-QAPP to achieve the project DQO.

1.6.1.3 Subcontract Laboratory Certification

Environmental laboratory services are to be provided only by laboratories holding a current National Environmental Laboratory Accreditation Program (NELAP) accreditation for all appropriate fields-of-testing and certified by the state of New York. Before testing services can be performed by the laboratory, the Contractor shall verify the candidate laboratory's acceptability by reviewing their certifications. NELAP accreditation information is to be provided annually. The laboratory shall notify the Engineer immediately of change in status of laboratory operations that may affect on-going compliance with these requirements. The EPA may, at any time, conduct audits (including requests for pertinent data or information) that support an environmental laboratory's declaration of compliance with its QA/QC program. If the EPA finds the laboratory is in non-compliance; the Contractor shall utilize alternate, compliant laboratory services until such time as compliance is again demonstrated. Before performing environmental testing, the laboratory shall have access to the approved QAPP.

1.6.1.4 Subcontracted Laboratory Performance

The Contractor shall provide continued acceptable analytical performance and shall establish a procedure to address data deficiencies noted by review and/or quality assurance sample results. The Contractor shall provide and implement a mechanism for providing analytical labs with the UFP-QAPP, for monitoring the lab's performance and for performing corrective action procedures. The Contractor shall acquire analytical services with NELAP accredited and State of New York certified laboratories.

1.6.2 Contractor QC Sample Collection and Analysis

QC samples shall be collected and analyzed by the Contractor in accordance with EPA's Contract Laboratory Program Guidance for Field Samplers (EPA 2007) (EPA 540-R-07-06) and other guidance documents and the Contractor's approved UFP-QAPP. QC samples shall be collected as described in the Contractor's approved UFP-QAPP. The following summarizes the minimum QC sampling requirements:

- Field duplicates shall be collected at a rate of at least one per every 20 samples to assess the overall precision of the field sampling technique.
- One trip blank shall be included with each daily shipment that contains aqueous samples collected for VOC analysis to verify the presence or absence of cross contamination in VOC samples during handling and shipment from the field to the laboratory.
- One field (or equipment/rinsate) blank shall be collected at a frequency of one per decontamination event, not to exceed one per day, for each equipment type and for each sample matrix to assess the effectiveness of equipment decontamination.
- One cooler temperature indicator or "temperature blank" will be placed in each cooler containing samples (solid and aqueous) for analysis to verify that samples have been maintained at 4° C.
- One matrix spike/spike duplicate (MS/MSD) will be collected at a rate of one per sample delivery group (SDG), as defined by EPA's Contract Laboratory Program Guidance for Field Samplers (Appendix F) to demonstrate the accuracy of laboratory analysis. MS/MSDs are not required for VOC and SVOC analysis in EPA Region 2.

1.6.3 Documentation of Sample Collection and Analysis

1.6.3.1 CLP/DESA Laboratory

The Contractor shall submit a trip report to the EPA RSCC within seven days of collection of the final sample in a CLP Case for samples analyzed by a CLP laboratory. The trip report shall include sample locations, dates of collection and shipment, identification of QC samples, and names of laboratories to which samples were submitted.

1.6.3.2 Subcontract Laboratory

The Contractor shall submit an ANSETS Data Requirement Form documenting analytical services provided by any subcontracted laboratory. (Attachment 5, Exhibit 1 of EPA Region II SOP HW-32). The form shall include the laboratory name and location, number of samples, analytical methods, and costs and be submitted at the end of each month, by the 5th of the next month following sample collection.

1.6.4 Review of Primary Laboratory Data

The Contractor shall be responsible for the independent data review of the entire data set.

1.6.5 Data Validation

The Contractor shall validate the analytical data for groundwater samples collected during the Baseline and Site-Wide Monitoring program, and as required for permit compliance in accordance with EPA validation guidances as applicable (http://www.epa.gov/region02/qa/documents.htm). Items such as instrument calibration, matrix spike recovery, duplicate differences, initial and continuing calibration checks, and laboratory control recovery will be assessed as part of the data validation. The data validation criteria shall be consistent with project DQOs and discussed in the approved UFP-QAPP. The Contractor shall prepare a data validation report, which shall include a summary of the independent data reviewer's findings. The summary shall consist of a table listing each QC result outside of established criteria, the established criteria, and the validation actions. Comments shall be included on how these data affect the validity of analytical results of the samples including data qualifiers used. The data validation report shall include, but not be limited to, the following parameters:

- Data completeness
- Method blank and field blanks
- Holding time including sample integrity
- Surrogate recovery
- Instrument calibration
- Matrix spike
- Continuing calibration verification
- Laboratory and field duplicate results
- Laboratory control samples
- Verification of sample results

The data validation reports shall be submitted as an appendix to the Chemical Data Final Report discussed in Paragraph 3.5.

1.7 ANALYTICAL DATA

1.7.1 Hard Copy

The chemistry data packages shall be re-produced and provided to the Engineer no later than 4 weeks after receipt of the analytical data package from the laboratory. The chemistry data package shall contain information to demonstrate that the project's DQO have been fulfilled.

1.7.2 Electronic Deliverables

All laboratory data shall be submitted in the Staged Electronic Data Deliverable (SEDD) format. Details on the SEDD format are provided in the SEDD Version 5.0 (or most recent version) specification located at http://www.epa.gov/superfund/programs/clp/sedd.htm.

1.8 QUALIFICATIONS

1.8.1 Chemical Quality Control Officer

As a minimum, the Contractor's Chemical Quality Control Officer shall have a Bachelor's Degree (B.A. or B.S.) in Chemistry, three years of experience with Hazardous Toxic and Radioactive Waste (HTRW) Quality Control including hazardous waste manifesting. The Chemical Quality Control Officer shall ensure that all chemistry related objectives including responsibilities for DQO definitions, sampling and analysis, project requirements for data documentation and validation, and final project reports are attained. The Chemical Quality Control officer need not be present on site during routine sampling, but shall be available for consultation with Government and Contractor personnel.

1.8.2 Environmental Sampler

As a minimum, the Contractor's Environmental Sampler shall have a B.A. or B.S. degree in Chemistry or closely related scientific/technical field, 3 years of experience in the development and preparation of UFP-QAPP, 1 year of experience in and knowledge of EPA methods for collecting environmental and hazardous waste samples and 1 year of experience in operation of field screening equipment (e.g. PID, FID etc.). The Environmental Sampler shall collect all onsite samples and perform all field-screening tests. The Environmental Sampler shall review the sampling results, and provide recommendations for the Contractor's sampling program.

1.9 COORDINATION MEETING

Before start of construction, the Contractor shall meet with the Engineer at the construction site to discuss the CQC Plan and the UFP-QAPP. The coordination meeting shall be simultaneous to any CQC coordination meeting required in SECTION 01451 - CONTRACTOR QUALITY CONTROL unless otherwise indicated or directed. A list of definable features of work that involve chemical measurements shall be agreed upon. At a minimum, each matrix (soil, water, air, instrumental chemical parameter measurement, etc.) shall be a definable feature of work. Management of the chemical data quality system including project DQO, project submittals, chemical data documentation, chemical data assessment, required sampling and analysis protocols, and minimum data reporting requirements shall be agreed upon. The meeting will serve to establish an interrelationship between the Contractor's chemical data quality management and Government chemical quality assurance requirements. Minutes of the meeting shall be documented by the Contractor and shall be signed by both the Contractor and the Engineer. The minutes shall include any or all unresolved chemical issues along with the conditions for resolution and shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by the Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor shall be responsible for chemical sample acquisition, sample analysis, instrumental measurements of chemical parameters and for chemical data quality control. An effective chemical data quality control system that meets the requirements for the chemical measurement DQO applicable to the project shall be established. The chemical data QC system shall consist of a chemical Quality Management staff responsible for the sampling and measurement plans, analytical procedures, minimum data reporting requirements and the organization necessary to produce the required chemical data.

3.2 CONTRACTOR QUALITY CONTROL PLAN

3.2.1 General

In addition to the quality control requirements specified in SECTION 01451 - CONTRACTOR QUALITY CONTROL, the CQC Plan shall incorporate the qualifications, authority and responsibilities of all chemical quality management and support personnel.

3.2.2 Chemistry Elements of the CQC Plan

To cover contract related chemical measurements by the Contractor and all subcontractors, the CQC Plan shall include the following as a minimum:

3.2.2.1 Qualifications

Names, education, experience qualifications, authorities, and decision-making responsibilities of all chemical quality management and support personnel. The CQC Plan shall contain a copy of a letter from the project QC manager designating and authorizing a Chemical Quality Control Officer and chemical quality control organization staff.

3.2.2.2 Authority and Responsibility

A diagram, flow chart, or figure clearly depicting the chemical data quality management and support staff and the authority and responsibility of each for chemical sampling and analysis, procedures for corrective actions, deliverables and submittals, deviations and changes, chemical quality documentation, data validation, minimum data reporting requirements, and DQO for chemical parameter measurement by the Contractor and subcontractors. The contents of this section of the CQC Plan shall be included in the applicable "Project Organization" elements of the QAPP.

3.3 Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP)

3.3.1 General

3.3.1.1 The UFP-QAPP shall contain necessary technical detail and direction for the field personnel to perform all onsite activities required to attain project DQO, including: collection of samples for offsite chemical analysis, shipment of samples for offsite analyses, and performance of onsite instrumental parameter measurements, data documentation and reporting requirements. It shall also contain sufficient direction and detail that analytical laboratory personnel understand analytical methods, method required detection limits, method QC requirements, data validation project data quality objectives and reporting requirements. The Contractor's developed QAPP shall be in accordance with EPA 505/B-04-900A, EPA 505/B-04-900B, EPA 505/B-04-900A-C, and the IDQTF,UFP-QAPP, March 2005.

3.3.1.2 The UFP-QAPP shall contain necessary technical detail and direction such that field and laboratory personnel understand all sampling and field measurement requirements. It shall document all aspects of the project, planning, implementation, assessment, corrective actions and reconciliation of completed tasks with documented planned objectives. It shall contain sufficient direction and detail that onsite personnel can perform all onsite activities required to attain project DQOs, including: collection of samples for off site chemical analysis, shipment of samples for off site analyses, and performance of onsite instrumental parameter measurements, data documentation and reporting requirements. The level of detail in the UFP-QAPP shall be such that any technically-competent personnel unfamiliar with the Site can follow the plan and perform all required work. It shall contain sufficient direction and detail that analytical laboratory personnel understand the analytical methods required and the project required reporting limits, project data quality indicators (DQIs) measurement performance criteria, project data validation and reporting requirements.

3.3.1.3 The Appendices section of the UFP-QAPP shall contain all contractor standard forms, project figures and tables, and SOPs, and all references pertaining to the project requirements included in the UFP-QAPP relating to project DQOs, standard and non-standard measurement method, equivalency data, U.S. Government and regional agency guidance and regulatory documents, existing site related documents, and other contract related chemical analysis documents. Reference to all applicable SOPs from EPA 540/P-87/001B, Compendium of Superfund Field Operation Methods, or Contractor SOPs, where applicable, shall be included.

3.4 CONTROL OF CHEMICAL DATA QUALITY

3.4.1 General

Contractor chemical data quality control shall ensure that a quality control program is in place that assures sampling and analytical activities and the resulting chemical parameter measurement data comply with the DQO and the requirements of the QAPP. The Contractor shall utilize the three phased control system that includes a preparatory, initial and follow up phase for each definable feature of work. The Contractor's three phase chemical data control process shall ensure that data reporting requirements are achieved and shall be implemented according to SECTION 01451 - CONTRACTOR QUALITY CONTROL. When possible, the three phase chemical data control process shall be combined with that under SECTION 01451 - CONTRACTOR QUALITY CONTROL.

3.4.2 Three Phase Process

3.4.2.1 The preparatory phase shall include a review of the specification, UFP-QAPP, and all relevant SOPs for the chemical parameter measurement and/or chemical sample acquisition and shipment. It shall include a physical examination of all required forms, materials and equipment to ensure conformance with the UFP-QAPP and that all materials are on site. It shall include a demonstration of sampling procedures by the Contractor's field sampling personnel.

3.4.2.2 The initial phase shall be performed at the initiation of each definable feature of work by the CQC Representative to confirm compliance with the QAPP, including: instrument calibration, operation and performance checks, sample acquisition, labeling, and shipment in accordance with required SOPs, sampling equipment decontamination, and completion of all required documentation.

3.4.2.3 The follow up phase shall require daily inspections to ensure compliance with the QAPP.

3.5 CHEMICAL DATA FINAL REPORT (CDFR)

The CDFR shall be produced including a summary of quality control practices employed and all chemical parameter measurement activities after project completion. As a minimum, the CDFR shall contain the following:

- ☐ Summary of project scope and description
- ☐ Summary of any deviations from the design chemical parameter measurement specifications
- ☐ Summary of chemical parameter measurements performed as contingent measurements
- ☐ Summary discussion of resulting data including achieving data reporting requirements
- ☐ Summary of DQO parameters including achieving sampling project specific DQO
- ☐ Presentation and evaluation of the data to include an overall assessment on the quality of the data for each method and matrix
- ☐ Internal QC data generated during the project, including tabular summaries correlating sample identifiers with all blank, matrix spikes, surrogates, duplicates, laboratory control samples, and batch identifiers
- ☐ A list of the affected sample results for each analytes (indexed by method and matrix) including the appropriate data qualifier flag (J, B, R, etc.), where sample results are potentially impacted by quality control criteria
- ☐ Summary of field and laboratory oversight activities, providing a discussion of the reliability of the data, QC problems encountered, and a summary of the evaluation of data quality for each analysis and matrix as indicated by the laboratory QC data and any other relevant findings
- ☐ Conclusions and recommendations

- Appendices containing: (1) Chemistry data packages (hard copy and in EPA Region II format according to SEDD version 5.0), and (2) Data validation reports and (3) The Chemical Data Quality Assurance Reports (CQAR).

3.6 NOTIFICATION OF NON-COMPLIANCE

The Engineer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice.

END OF SECTION

SECTION 01451

CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.1 SCOPE OF WORK

Furnish the labor, supervision, materials, equipment and services required to prepare a Contractor Quality Control (CQC) Plan for approval by the Engineer and to perform Contractor quality control in accordance with the approved CQC Plan.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740	Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	Agencies Engaged in Testing and/or Inspection of Materials as Used in Construction

1.3 SUBMITTALS

Submittals shall be made as specified in SECTION 01330 - SUBMITTAL PROCEDURES. The Contractor Quality Control organization shall be responsible for certifying that all submittals are in compliance with the contract requirements and are submitted in accordance with the date on the submittal register. CQC personnel shall also make physical checks of materials and equipment before installation to insure compliance with approved submittals.

1.3.1 CQC Plan; Pre-Construction Submittals; EA

The Contractor shall develop and submit to the Engineer for approval, a detailed CQC Plan, as specified in Paragraph 3.2 - QUALITY CONTROL PLAN.

1.3.2 CQC Organizational Changes; Product Data; EA

Any CQC organizational changes made during the Contract Period shall be submitted to the Engineer for acceptance.

1.3.3 CQC Reports; Product Data; FIO

The Contractor shall submit CQC reports, as specified in Paragraph 3.9 - DOCUMENTATION.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system. The CQC system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the contract requirements. The system shall cover all construction operations, both on site and off site, and shall be keyed to the proposed construction sequence. In this section the term "construction" shall include all items of work, activities, materials, and equipment as indicated in the Contract Documents. Other sections of the Contract Documents may also require separate, specially qualified individuals in such areas as chemical data acquisition, sampling and analysis, medical monitoring, industrial hygiene, safety officer, etc. The CQC organization shall coordinate the activities of these individuals. The EPA's Construction Management Contractor, herein referred to as the Remedial Action (RA) Contractor shall be held responsible for the quality of work on the job and is subject to removal by the Engineer for non-compliance with quality requirements specified in the contract. The RA Contractor in this context shall mean the on-site individual with the responsibility for the overall management of the project including logistics and production.

3.2 QUALITY CONTROL PLAN

3.2.1 General

The Contractor shall furnish for review by the Engineer, not later than 21 calendar days prior to the Pre-Work Conference, the Contractor Quality Control Plan proposed to implement the requirements herein. The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the definable features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all aspects of the design and construction operations, both on site and off site, including work by subcontractors, fabricators, suppliers, and purchasing agents:

3.2.2.1 A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include the RA contractor, a Contractor's QC officer, a Resident Engineer, and a Subcontractor Quality Control (SQC) Manager.

3.2.2.2 The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

3.2.2.3 A copy of the letter to the RA Contractor signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the RA Contractor, including authority to stop work which is not in compliance with the contract. The RA Contractor shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Engineer.

3.2.2.4 Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with SECTION 01330 - SUBMITTAL PROCEDURES.

3.2.2.5 Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities will be approved by the Engineer.) The Contractor shall incorporate all tests required by the Contract Documents (including systems commissioning and operating tests) to derive the above list of testing information which shall be presented in matrix form as part of the CQC Plan. This matrix shall be suitable for use by the Contractor and the Engineer as a checklist to control testing to be done on the contract. Coordinate any additional test submission or plan requirements for Mechanical and Electrical Systems with appropriate specialized specification section if applicable.

3.2.2.6 Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation. Provide matrix of Preparatory and Initial Inspections including specification reference paragraph, the name of the Definable Feature of Work, and spaces for date performed, results, and names of attendees.

3.2.2.7 Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.

3.2.2.8 Reporting procedures, including proposed reporting formats.

3.2.2.9 A list of the definable features of work. A definable feature of work is a task that is separate and distinct from other tasks and has separate control requirements. It could be identified by different trades or disciplines, or it could be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there is frequently more than one definable feature under a particular section. This list shall cover all features of work on the project, and shall be agreed upon during the coordination meeting.

3.2.2.10 Contractor's plan for training all CQC personnel.

3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Engineer reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Engineer in writing of any proposed changes. Proposed changes are subject to acceptance by the Engineer.

3.3 QUALITY CONTROL OF DESIGN ACTIVITIES

All design work products shall undergo thorough and continuous checking in accordance with the Contractors approved CQC Plan. Checking shall be done by staff who are knowledgeable in the work being checked and independent of the specific work product.

The reviewer's name and date shall be printed on each work product. Whenever practical, work shall be performed on standard computation sheets, which contains a header requiring this information. The title box of drawings also requires this information. The reviewer's name and date are considered evidence that work products have been checked, and shall be provided to the technical reviewer of the design report.

3.3.1 Checking Calculations, Tables, Charts, and Data Sheets

Calculations, tables, charts, and data sheets shall be checked by an independent reviewer. Checking shall be performed throughout the design process. The complete thought process and mathematics shall be reviewed. The applicable formulas and design criteria shall be referenced on the computation paper or spreadsheets, and reviewed during the checking process. Corrections shall be clearly noted on the calculations and erroneous figures shall be crossed out. Revisions shall be reviewed with the individual who made the original calculations.

3.3.2 Checking Drawings, Maps, and Sketches

Drawings, maps, and sketches shall be checked by an independent reviewer. Checking of all drawings, maps, and sketches shall be performed prior to the design submittals. Questions or corrections shall be clearly noted and discussed with the preparer of the work product.

3.3.3 Technical Review

All work including shop drawing submittals shall be subject to independent technical reviews. Technical reviews of all documents shall be performed prior to submission. Technical document review is a critical review of work by one or more qualified reviewers who are independent of the document reviewed. The review is performed to ensure technical accuracy, accomplishment of project objectives, and conformance to established requirements.

3.4 PRE-CONSTRUCTION QUALITY CONTROL CONFERENCE

After the Pre-work Conference, before start of construction, and prior to acceptance by the Engineer of the CQC Plan, the Contractor shall meet with the Engineer and discuss the CQC system. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both on site and off site work, and the interrelationship of Contractor's management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Contractor in accordance with SECTTION 01201- PRE-CONSTRUCTION AND PRE-WORK CONFERENCE and signed by both the Contractor and the Engineer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences shall be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by the Contractor.

3.5 QUALITY CONTROL ORGANIZATION

3.5.1 General

The requirements for the CQC organization are a Contractor QC Manager and sufficient number of additional qualified personnel to ensure contract compliance. The number of CQC personnel shall be increased as required during times of high construction workload. The Contractor shall provide a CQC organization that shall be at the site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by the Engineer. Complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Engineer.

3.5.2 Contractor QC Manager

The Contractor shall identify as Contractor QC Manager an individual within his organization at the site of the work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The Contractor QC Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, or shall hold a state Professional Engineer's license, with a minimum of 2 years construction experience on construction similar to this contract, one year of which as a QC Representative. The Contractor QC Manager may also be a construction person with a minimum of 4 years in related work, one year of which as a QC Representative. This Contractor QC Manager shall be on the site at all times during construction and shall be employed by the Contractor.

3.5.3 Organizational Expertise

The CQC organization must as a minimum possess general corporate technical knowledge of all aspects of the project, and must successfully execute the CQC System on all aspects of the project. Individuals possessing experience in specialized areas shall be added to the organization as required during periods when such specialty areas are being executed. Examples of such specialized areas would include heating, ventilation, and air-conditioning (HVAC), electrical distribution and substations, roofing, tele-communication systems, fire protection and alarm systems, computer installations, specialized welding, specialized finishes, pre-cast concrete installation, modular housing, surveying, chemical data acquisition, hazardous material removal and disposal, medical monitoring, , etc., depending on the nature of the particular project. The Contractor must demonstrate that such additional qualified personnel have received sufficient training and indoctrination into the CQC system, and that these personnel properly execute the requirements of the CQC System within their areas of expertise.

3.5.4 Additional Requirement

In addition to the above experience and education requirements the RA Contractor shall have completed within the last five years the course titled "Construction Quality Management for Contractors". This course is given at a cost of $125 by Government personnel and is of two-day duration. The Government shall provide one instruction manual for the course.

3.5.5 Organizational Changes

The Contractor shall maintain the CQC Organization at all times. When it is necessary to make changes to the organization, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Engineer for acceptance.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the RA Contractor for each definable feature of work as follows:

3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work after all required plans/documents/materials are approved/accepted, and after copies are at the work site, and shall include:

3.6.1.1 A review of each paragraph of applicable specifications.

3.6.1.2 A review of the contract drawings.

3.6.1.3 A check to assure that all materials and/or equipment have been tested, submitted, and approved.

3.6.1.4 Review of provisions that have been made to provide required control inspection and testing.

3.6.1.5 Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

3.6.1.6 A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

3.6.1.7 A review of the appropriate activity hazard analyses to assure safety requirements is satisfied.

3.6.1.9 Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

3.6.1.10 A check to ensure that the portion of the plan for the work to be performed has been approved by the Engineer.

3.6.1.11 Discussion of the initial control phase.

3.6.1.12 The Engineer shall be notified at least 48 hours in advance of beginning the preparatory control phase meeting. This phase shall include a meeting conducted by the RA Contractor and attended by other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the Contractor's QC officer and attached to the daily CQC report. The Contractor shall clearly indicate its intent and plan for communication of the results of the preparatory phase to applicable workers, to include materials, construction methods, workmanship standards, safety considerations and procedures, and preparatory phase meeting minutes.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a Definable Feature of Work (DFW) when the accomplishment of a representative sample of the work is impending. The following shall be accomplished:

3.6.2.1 A check of the portion of work done to ensure that it is in full compliance with contract requirements.

3.6.2.2 Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

3.6.2.3 Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

3.6.2.4 Resolve all differences.

3.6.2.5 Check safety to include compliance with and upgrading of the Site Safety and Health Plan. Review the activity hazard analysis with each worker.

3.6.2.6 The Engineer shall be notified at least 48 hours in advance of beginning the initial phase meeting. This phase shall include a meeting conducted by the RA Contractor and attended by other CQC personnel (as applicable), and the foreman responsible for the definable feature and the work crew(s) for the appropriate DFW. Separate minutes of this phase shall be prepared by the Contractor's QC officer and attached to the daily CQC report. Exact location (i.e. CQC Report number) of initial phase shall be indicated for future reference and comparison with follow-up phases.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work that may be affected by the deficient work. The Contractor shall not build upon or conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable feature of work if the quality of on-going work is unacceptable, if there are changes in the applicable CQC staff, onsite production supervision or work crew, if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.6.5 Definable Feature of Work: Definition and Discussion

A DFW is a portion of work consisting of materials, equipment, supplies and procedures which are closely related to each other, have the same control and shall be accomplished by the same work crew to completion. A DFW must be sufficiently small so that control of the work (i.e. communication of requirements to workers, inspection of materials and workmanship and correction of deficiencies) will be easily accomplished. Some examples for various types of DFW's are:

- Clearing and grubbing
- Extraction and monitoring wells installation
- Wells development
- Extraction well testing
- Yard piping trenching and installation
- Pilot testing for iron removal system
- Groundwater treatment building construction

- Groundwater treatment system equipment installation
- Rough-in of electrical boxes and wiring methods
- Lighting fixtures, receptacles, and accessories
- Panelboards, circuit breakers and motor control centers
- Power supply
- Water supply piping, fittings and supports
- Start-up and performance testing
- Wastewater/groundwater sampling
- Concrete reinforcement and formwork
- Concrete mixing, placement, curing and finishing
- Chemical Data Acquisition
- Operation and maintenance

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product that conforms to contract requirements. Upon request, the Contractor shall furnish to the Engineer duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall perform the following activities and record and provide the following data:

3.7.1.1 Verify that testing procedures comply with contract requirements.

3.7.1.2 Verify that facilities and testing equipment are available and comply with testing standards.

3.7.1.3 Check test instrument calibration data against certified standards.

3.7.1.4 Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

3.7.1.5 Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Engineer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an off site or commercial test facility shall be provided directly to the Engineer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment and calibration in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, aggregate and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329. The Government requires a capability check of the laboratory that the Contractor proposes to perform tests on soils, concrete, asphalt, aggregate and steel.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor shall be assessed a charge to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory.

3.7.3 On-site Laboratory

The Engineer reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost of the Government.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Engineer shall be delivered to the USEPA-designated Quality Assurance (QA) laboratories.

Coordination of each specific test, exact delivery location, and dates shall be made through the USEPA-designated QA laboratories. The Contractor shall ensure that sufficient notice is given to USEPA prior to sample delivery.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the completion of all work required for completion of the groundwater treatment system,, the Contractor's QC officer shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation as required herein, and shall include the estimated date by which the deficiencies will be corrected. The Contractor's QC officer or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished the Contractor shall notify the Engineer that the facility is ready for the "Pre-final" inspection.

3.8.2 Pre-Final Inspection

The Engineer will perform this inspection to verify that the project has been completed. A "Pre-final Punch List" will be developed as a result of this inspection. The Contactor shall ensure that all items on this list have been corrected and shall notify the Engineer so that a "Final" inspection with the USEPA can be scheduled. Any items noted on the "Pre-final" inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

3.8.3 Final Inspection

The Contractor's Quality Control Inspection personnel, plus the RA Contractor or other primary management person and the Engineer's representative will be in attendance at this inspection. Additional Government personnel including, but not limited to, those from USEPA, and State and local officials may also be in attendance. The final inspection will be formally scheduled by the Engineer based upon results of the Pre-Final Inspection. Notice shall be given to the Engineer at least 14 calendar days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, shall be complete and acceptable by the date scheduled for the final inspection.

3.8.4 Post-Final Acceptance Inspection

Following the one-year operational and functional period, a post-final acceptance inspection shall be conducted. The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person and the Engineer's representative will be in attendance at this inspection. Additional Government personnel including, but not limited to, those from USEPA, and State and local officials may also be in attendance. Notice shall be given to the Engineer at least 14 calendar days prior to the final acceptance inspection.

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on the applicable forms, Daily CQC Reports, List of Outstanding Deficiencies, CQC Test Report List, and Record of Preparatory and Initial Inspections that includes, as a minimum, the following information:

3.9.1 Contractor/subcontractor and their area of responsibility.

3.9.2 Operating plant/equipment with hours worked, idle, or down for repair.

3.9.3 Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

3.9.4 Test and/or control activities performed with results and references to Contract Document requirements. The control phase should be identified (Preparatory, Initial, and Follow-up). List deficiencies noted along with corrective action.

3.9.5 Quantity of materials received at the site with statement as to acceptability, storage, and reference to Contract Document requirements.

3.9.6 Submittals reviewed, with contract reference, by whom, and action taken.

3.9.7 Offsite surveillance activities, including actions taken.

3.9.8 Job safety evaluations stating what was checked, results, and instructions or corrective actions.

3.9.9 Instructions given/received and conflicts in the Contract Documents.

3.9.10 Contractor's verification statement.

These records shall indicate a description of trades working on the project, the number of personnel working, weather conditions encountered, and any delays encountered. "N/A" shall be entered into any field for which no entry is intended. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Engineer daily within 16 hours after the date(s) covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every seven days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the Contractor. The report from the RA Contractor shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel. All documentation is expected to be legible and complete.

3.10 SAMPLE FORMS

3.10.1 The 2-page form at the end of the section shall be used for the basic CQC Report. CQC personnel shall attach continuation sheets as required for any entries that cannot fit on the basic form. Preparatory and Initial Inspections, when performed, shall be indicated on the basic CQC report and minutes for each inspection shall be attached. Minutes shall consist of a list of specific requirements for materials, procedures or equipment to be employed and shall also include any understandings reached or items of special importance discussed.

3.10.2 In addition, outstanding deficiencies shall be listed on the form "List of Outstanding Deficiencies" at the end of this section and shall be attached to each CQC report. As deficiencies are corrected, they are to be acknowledged on the basic CQC report and shall be deleted from the list.

3.10.3 The form at the end of this section titled "CQC Test Report List" shall be used by the Contractor to track testing to be done as the project progresses, and also to summarize the Contractor's Quality Control testing to be reported on the CQC Plan.

3.10.4 Form "Record of Preparatory and Initial Inspections" at the end of this section shall be used by the Contractor to track Preparatory and Initial inspections as the project progresses and also to summarize these required inspections as part of the CQC Plan.

3.10.5 Additional reporting forms pertaining to specialized activities may be included herein or elsewhere in the contract, and shall be used for reporting as indicated.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Engineer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor. Deficiencies cited and verbal instructions given to the Contractor by the Engineer shall be entered into that day's CQC Report.

END OF SECTION

CQC REPORT #__________ Date:____________________

1. Project Title:____

Location: ____________________ Contract No.:____________________

2. List Contractors and Subs Working This Day and Areas of responsibility of each

____

____

____

____

3. Weather:

____

____

4. Description and Location of Work of the Project (Also indicate days of no work and reasons for delay)

____

____

____

____

____

____

5. Labor and Equipment Breakdown by Trade (Attach Continuation)

____

____

____

____

6. Preparatory Phase Inspections Held (See attached minutes)

____

____

____

____

____

7. Initial Phase Inspections Held (See attached minutes)

____

____

____

____

____

____

8. Follow-Up Phase Inspections Performed, Results and Corrective Actions Taken

9. Job Safety. Indicate What Was Checked, Results, Instructions Received and Corrective Actions Taken

10. Additional Activities and Remarks (Check Appropriate Box)

[ ] a. Testing Performed. Attach Results.
[ ] b. Verbal Instructions Received.
[ ] c. Submittal Actions.
[ ] d. Outstanding Deficiencies. See Attached List
[ ] e. Delivery of Equipment and Materials.
[ ] f. Misc/Remarks.

(Use Space Below To Describe Checked Items)

11. Contractor's Verification: "The above report and attachments are complete and all supplies, Materials, Equipment and Workmanship incorporated into the work are in full compliance with the contract except as noted".

Signed______________________________ Date__________
CQC Representative

LIST OF OUTSTANDING DEFICIENCIES

Page_______ of _______ DATE:__________

PROJECT TITLE:________________________________ CONTRACTOR:____________________

LOCATION:______________ CQC REPORT#:________ CONTRACT #:________________________

SPEC REF OR DWG#	LOCATION ON PROJECT	DESCRIPTION OF DEFICIENCY	DATE FOUND	DATE TO BE CORRECTED	DATE CORRECTED	REMARKS

NOTE: THIS FORM SHALL BE USED BY THE CONTRACTOR TO TRACK OUTSTANDING CONSTRUCTION DEFICIENCIES

CQC TEST REPORT LIST

CQC REPORT#__________________ Page_______ of _______ DATE:_____________

CONTRACTOR:____ CONTRACT #:________________________________

PROJECT TITLE:____ LOCATION:_____________________

SPEC REF OR DWG#	TYPE OF TEST	DATE PERFORMED	RESULTS	REMARKS

NOTE: THIS FORM SHALL BE USED BY THE CONTRACTOR TO TRACK CQC TESTING.PROVIDE ATTACHMENTS AS REQUIRED.

RECORD OF PREPARATORY AND INITIAL INSPECTIONS

DATE OF INSP	TYPE OF INSP	DEFINABLE FEATURE OF WORK (DESCRIBE)	REPORT NOS		PERSONS ATTENDING INSP	WAS MATL&/OR EQUIPMENT PHYSICALLY INSPECTED ?
			QA	QC		

NOTE:THIS FORM SHALL BE USED BY THE CONTRACTOR TO TRACK PREP/INIT INSP'S
ATTACH ADDITIONAL RESULTS OR COMMENTS AS REQUIRED

SECTION 01500

TEMPORARY CONSTRUCTION FACILITIES AND UTILITIES

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall provide all the temporary construction support facilities required to execute this Contract and comply, at minimum, with the requirements specified herein. All structures installed under this section shall be removed at the completion of the project.

1.1.2 Facilities shall be temporary structures or rented permanent structures and shall consist of the following:

- Engineer's site office
- Contractor's site office
- Equipment and materials storage areas
- On site sanitary facilities for workers
- Decontamination facility
- Parking area

1.1.3 Temporary facilities shall be located at the staging area shown on the Contract Drawings.

1. 2 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 – SUBMITAL PROCEDURES.

1.2.1 Temporary Site Facility Layout Plan; Shop Drawings, EA

The Contractor shall submit a Temporary Site Facility Layout Plan to the Engineer for approval at least 30 days prior to field mobilization for onsite construction. At a minimum, the Contractor's Site Layout drawing shall include the following information:

1.2.1.1 General layouts of temporary site facilities including trailers, emergency medical facilities, equipment storage area, decontamination area, and other staging areas.

1.2.1.2 Trailer(s) - floor plans, fixtures, and materials of construction.

1.2.1.3 Electricity supply and lighting - source point, layout locations, fixtures and materials.

1.2.1.4 Water supply, contaminated wastewater handling, and sanitary facilities - locations, layout, fixtures, materials, and methods of sanitary waste disposal.

1.2.1.5 Fences - proposed location and dimensions, avenues of ingress/egress and details of installation.

1.2.1.6 Decontamination - design of the temporary decontamination pad

1.3 REGULATORY REQUIREMENTS

1.3.1 The Contractor shall obtain all necessary construction, building, zoning, or soil erosion and sediment control permits required by local authorities.

1.3.2 The Contractor shall provide notification to the Engineer regarding all permits required by the local authorities prior to pursuing and obtaining such permits.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 All structures other than storage sheds installed under this section shall be provided with, as a minimum, the following services:

2.1.1.1 Lighting. Electric light, non-glare type luminaries to provide a minimum illumination level of 50 foot-candles at desk height level.

2.1.1.2 Heating and Cooling. Adequate equipment to maintain an ambient air temperature of 70-degrees Fahrenheit (F) + 3 degrees.

2.1.1.3 Potable bottled water.

2.1.1.4 Fire Extinguisher - Non-toxic, dry chemical, fire extinguisher meeting Underwriters Laboratories, Inc., approval for Class A, Class B and Class C fires with a minimum rating of 2A; 10B; and 10C.

2.1.1.5 Janitorial services on a daily basis including but not limited to sweeping, emptying wastebaskets, servicing of toilets, weekly mopping of floors, sanitizing toilet seats, providing towels and soap to the lavatories and monthly washing of floors and windows (inside and out). The time of the cleaning shall be coordinated with the Engineer.

2.1.1.6 Sufficient supply of electrical outlets.

2.1.2 All parking areas shall be provided with adequate outdoor lighting as specified herein.

2.2 Engineers Field Office

2.2.1 The Contractor shall provide temporary site office facilities for use by the Engineer according to the following minimum requirements. The facilities may be in a storefront, trailer, or other suitable permanent or temporary building. At a minimum, the temporary site office shall be outfitted with the following items, which may be rented, used, or new:

- Two desks
- Four chairs
- One oversize desk surface for drawings
- Lockable file cabinets
- Wastebasket
- Bulletin board
- Microwave
- Mini-fridge
- Coffee Maker
- Paper Shredder
- Two-way radios
- One office conference table with eight chairs

2.2.2 A minimum of four telephone lines, one dedicated to fax, one dedicated to modem (DSL) and two dedicated to voiceshall be installed for the Engineer's temporary site office. All telephone and internet connection costs including installation, service charged and discontinuance are the responsibility of the Contractor. If high speed internet service is not available, the Contractor shall provide a wireless high speed internet connection service for both computers.

2.2.3 In addition to the above, the Contractor shall provide the following computers, computer accessories and office equipment, and other items for use by the Government during the contract. No separate payment will be made for providing the following items and all costs in connection therewith will be considered the obligation of the Contractor.

2.2.3.1 The contractor shall supply two laptop computers from recognized computer hardware manufacturers Dell, Gateway, Compaq or equal. Docking stations shall be included. Minimum requirements are as follows: Pentium IV processor with 2.8 GHz with 2 GIG of RAM or better, 160 GB, 7200 rpm hard drive. DVD-ROM and 40X CD Writer. Sound Card with speakers. 19" (minimum) flat panel LCD color monitor with refresh rate 75 Hertz or better. Modem V.92 56 KB Baud (dial-up) or 10/100 MB 3COM network card (network connection) with cable. G-Force 4 TI 4600 Video Card or better. Enhanced 101 keyboard. Intellimouse optical mouse and mouse pad. Supply adjustable keyboard shelf (installed) and wrist rests with room for keyboard and mouse.

Operating and software requirements: (pre-loaded, working, user's manuals, with licenses acquired for all computers, and including upgrades during the project, supply latest version of each). Microsoft Window XP Professional, NTFS File System for Windows XP Professional, Microsoft Office XP SBE, Microsoft Project, scheduling software used by the contractor to develop project schedule, Adobe Photo Deluxe Business Edition, AutoCAD with Civil 3D, Norton Anti-Virus

2.2.3.2 Personal Computer Accessories Requirements:

The Contractor shall provide two computer docking stations, two monitors, and two key boards compatible with the Engineer's personal computers. The Contractor shall verify the proper make/model with the Engineer at the time of purchase so all accessories will be compatible. The accessories shall have the following requirements:

- 6 outlet surge protector
- All required connecting cables and plugs

2.2.3.3 Scanner:

- To be included in the printer

2.2.3.4 Digital Camera:

A digital camera, which shall meet the following minimum requirements:

- 4.0 megapixel (2,240 x 1,680 resolution) or better
- 48 Bit Color Depth
- 2 GB SD card or better
- 3x Optical Zoom
- 1.8" TFT LCD Monitor
- 3 Modes Built in Flash
- Wide aperture setting (f-stop): f2

2.2.3.5 Printer:

A multi-function color printer, including scanner and copier functions. Supply of paper and toner shall be replenished by the Contractor as required by the Engineer.

2.2.3.6 Copier:

Plain-paper, desktop, autofeed, reduction, enlargement, sorting, stapling, monochrome, minimum 10 copies per minute (may be shared by Contractor and Engineer if approved by Engineer). The copier shall be equipped with individual trays for 8.5" x 11", 8.5" x 14", and 11" x 17" paper. The supply of paper and toner shall be replenished by the Contractor as required by the Engineer. The Contractor shall also provide copier service as required.

2.2.3.7 Fax Machine:

Monochrome, minimum feed three - 8 1/2" x 11" pages per minute. Capable of receiving on plain white paper (may be shared by Contractor and Engineer if approved by Engineer).

2.2.3.8 Telephone:

2-line phone with conferencing and speaker phone capabilities compatible with phone service.

2.2.3.9 Telephone Answering Machine (or voice mail):

Standard, compatible with standard telephone line and local service, with remote message retrieval capability.

2.2.3.10 First Aid Kit:

As a minimum the kit shall include antiseptic kit, eyewash solution, bandages, insect sting medication, aspirin and acetaminophen, and cold pack.

2.3 CONTRACTOR'S TEMPORARY FACILITIES

2.3.1 Administrative Field Office

The Contractor shall provide and maintain an administrative field office and facilities at the site. The field offices shall be outfitted to the discretion of the Contractor. At minimum, continuous, hard-line telephone service shall be provided for emergencies.

2.3.2 Parking

Contractor employees shall park privately owned vehicles in an area designated by the Engineer. This area will be within reasonable walking distance of the site. All parking areas shall be provided with adequate outdoor lighting.

2.4 DECONTAMINATION FACILITIES

2.4.1 The Contractor shall provide the equipment and materials necessary to properly decontaminate all onsite equipment that comes in contact with contaminated materials. Decontamination facilities shall, at a minimum, be constructed with a plywood base, wood timber sides, and polyethylene sheeting for containment of decontamination fluids and sediment. Decontamination equipment shall, at minimum, include pressure washing equipment and wire brushes.

2.4.2 All wash water shall be conveyed from the decontamination pad and disposed of at an approved facility or shall be treated on-site as approved by the Engineer.

2.5 OUTDOOR LIGHTING

The Contractor shall furnish and install a complete operating outdoor lighting system through the designated support zone. The lighting system shall include wood pole mounted 400-watt high-pressure sodium luminaries supported on 4-foot steel arms with 30-feet mounting height above grade. The system shall include all equipment and materials and conductors. Shop drawings shall be submitted showing the layout, equipment and material details, and circuits prior to installation.

2.6 SANITARY WASTE SYSTEM

2.6.1 Onsite sanitary facilities shall consist of chemical type toilets. No toilet facilities shall be provided in the Exclusion Zones. The Contractor shall periodically empty wastes, which shall be disposed of at an approved facility. Waste may be emptied to a municipal, district or station sanitary sewer if approval from the system owner is obtained.

2.6.2 The Contractor shall provide a portable wash unit and collection system for equipment decontamination, hand washing, and as specified elsewhere.

PART 3 EXECUTION

3.1 LOCATION

The Contractor shall utilize the Contractor's Staging Area shown on the Contract Drawings for all temporary facilities or as approved by the Engineer.

3.2 MAINTENANCE

The Contractor shall maintain all temporary construction facilities and shall perform all necessary repairs, replacement, cleaning and any other maintenance required as directed by the Engineer. Included in this maintenance shall be sweeping and any other cleaning necessary to keep the project vicinity area free of soil, dust and debris.

END OF SECTION

SECTION 01550

SURVEYING

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, materials, equipment and incidentals required to provide survey services prior to remediation activities, after remediation activities and as measurement during remediation activities as specified herein.

1.1.2 The Contractor shall verify the exact position or location of all work control points provided by the Engineer and verify the existing conditions, contours and location of structures within the construction limits defined on the Contract Drawings.

1.1.3 The Contractor shall prepare As-Built Drawings which will detail the actual conditions of trenching, piping, building and groundwater treatment system upon the completion of work.

1.1.4 The horizontal coordinate system shall be the New York State Plane Coordinate System, Long Island Zone, North American Datum 1983 (NAD83) datum. The elevation datum shall be North American Vertical Datum (NAVD88).

1.2 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The Contractor shall submit the following to the Engineer in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.2.1 Surveyor Qualifications; Product Data; FIO

Name, address, New York registration number, and telephone number of the surveyor shall be submitted to the Engineer before starting survey work.

1.2.2 Survey Accuracy Documentation; Product Data; FIO

1.2.2.1 On request, documentation verifying accuracy of survey work shall be submitted to the Engineer by the Contractor.

1.2.2.2 Certificates signed by the surveyor stating that elevations and locations of site construction features are in conformance, or nonconformance, with Contract Documents shall be submitted to the Engineer at the completion of each phase of work requiring services of the surveyor.

1.2.3 Surveyor Field Notes; Product Data; FIO

Copies of the surveyor's field notes, calculations, and graphical layouts.

1.2.4 As-Built Drawings; Closeout Submittal; EA

As-Built Drawings shall be submitted in accordance with Paragraph 3.3.6.

1.3 QUALITY CONTROL

1.3.1 The Contractor shall be responsible for all of the surveying done at the site. The surveyor shall be a qualified and Registered Land Surveyor in the State of New York. The Contractor's surveyor shall also have a minimum of two years of experience in construction surveying, and layout and maintenance of as-built construction drawings, with a record of performing horizontal and vertical control requirements as stated in this section.

1.3.2 The surveyor shall check all equipment including, but not limited to electronic survey instruments, compasses, transits, and levels for accuracy and maintain records of such checks. The Subcontractor shall make records of the checks available to the Contractor upon request.

1.3.3 All survey work will be according to third-order accuracy standards as specified by the Federal Geodetic Control Committee in the "Standards and Specifications for Geodetic Control Networks", published September 1984. The units of measure shall be U.S. Survey Feet. Unless otherwise specified, the well location shall have a vertical precision of 0.010 feet, and a horizontal precision of 0.10 feet.

1.4 PROJECT RECORD DOCUMENTS

1.4.1 A complete, accurate log of control and survey work as it progresses shall be maintained at the work site by the Contractor.

1.4.2 Upon completion of the work, all record documents must be submitted to the Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 INSPECTION

The Contractor shall verify locations of site reference and survey control points prior to starting work. The Engineer must be promptly notified of any discrepancies discovered.

3.2 SURVEY REFERENCE POINTS

3.2.1 The Engineer will provide the Contractor with all site reference points after Notice to Proceed.

3.2.2 The Contractor shall take all reasonable measures to protect site reference points prior to starting site work. Reference points shall not be relocated without prior written approval of the Engineer.

3.2.3 The Engineer will be immediately notified of loss, damage, or destruction of any reference point, or any relocation required because of changes in grade or other reasons.

3.2.4 Temporary monuments shall be set as necessary to perform the surveying. They may be wood, metal or marks scribed on permanent site features. All monuments shall be described in the field notes and marked on site maps for future reference.

3.3 SURVEY REQUIREMENTS

3.3.1 The Contractor shall establish the exact position or location of all work control points. All work shall be referenced to and established from the control points, re-established where necessary and maintained throughout the life of the contract. Any error or apparent discrepancies found in the Contract Documents shall be called to the Engineer's attention for interpretation prior to proceeding with the work.

3.3.2 The Contractor shall verify the existing conditions, contours and locations of structures within the construction limits defined on the Contract Drawings.

3.3.3 The Contractor shall establish lines and levels, and locate and layout by instrumentation and similar appropriate means, all site features to be constructed or executed. These include, but are not limited to the following:

- Treatment building
- Groundwater extraction wells and monitoring wells
- Groundwater treatment system
- Influent and effluent yard piping
- Access roads
- Fence lines
- Final site grading

3.3.4 The Contractor will re-verify layouts periodically during construction by same means.

3.3.5 Groundwater extraction wells shall be surveyed in accordance with SECTION 02525 -WELL INSTALLATION.

3.3.6 As-built Drawings

3.3.6.1 The Contractor shall prepare as-built drawings that identify the features listed in Paragraph 3.3.3 above. All areas disturbed and restored shall be clearly identified.

3.3.6.2 The drawings shall also include as-built features for the treatment system and building. The drawings shall show the as-built position, size, and arrangement of, but not be limited to, foundations, treatment equipment, piping, ductwork, controls, mechanical, electrical, instrumentation, utilities, doors, windows, louvers, roof and wall penetrations, sumps, and containment structures.

3.3.6.3 The Contractor shall submit three paper copies of the as-built drawings to be signed and sealed by a New York licensed surveyor.

3.3.6.4 The Contractor shall also submit an electronic deliverable that includes an electronic copy of the as-built drawings compatible with AutoCAD 2008. The electronic copy shall be identical to the submitted paper copies. The contractor shall also submit a text file or MS Excel file that includes a list of all survey points. For each point, the file shall include a point number, description, X-coordinate, Y-coordinate, and elevation.

END OF SECTION

SECTION 01580

SIGNS

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish all labor, equipment, materials and incidentals required to provide and erect a U.S. Environmental Protection Agency (USEPA) project site sign, safety signs and a bulletin board.

1.1.2 The Contractor shall provide and erect a USEPA project site sign and safety signs meeting the requirements of this section, at a location to be determined by the Engineer. The sign requirements are shown at the end of this section. Wording to be included on the sign shall be provided by the Engineer after award.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1903	Inspections, Citations, and Proposed Penalties

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Materials shall conform to the requirements as shown on the Drawings at the end of this section and shall be suitable for use in an unprotected exterior environment.

2.1.2 Dollar amounts and wording changes shall be provided by the Engineer after award.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall place signs on the work area fence that bear the legend, in letters at least four inches high:

WARNING
HAZARDOUS WORK AREA
DO NOT ENTER UNLESS AUTHORIZED

The Contractor shall post hazard warning banners at areas of special hazard including, but not limited to the perimeter of the Exclusion Zone. The Contractor shall provide all signs required on the Contract Drawings. Letters shall be at least four inches high.

3.2 INSTALLATION REQUIREMENTS

The USEPA project site sign and the safety signs are to be mounted on 4-inch by 4-inch by 8-foot treated timbers and set firmly into the ground above prevailing grade to permit public viewing and shall be installed during site mobilization.

3.3 BULLETIN BOARD

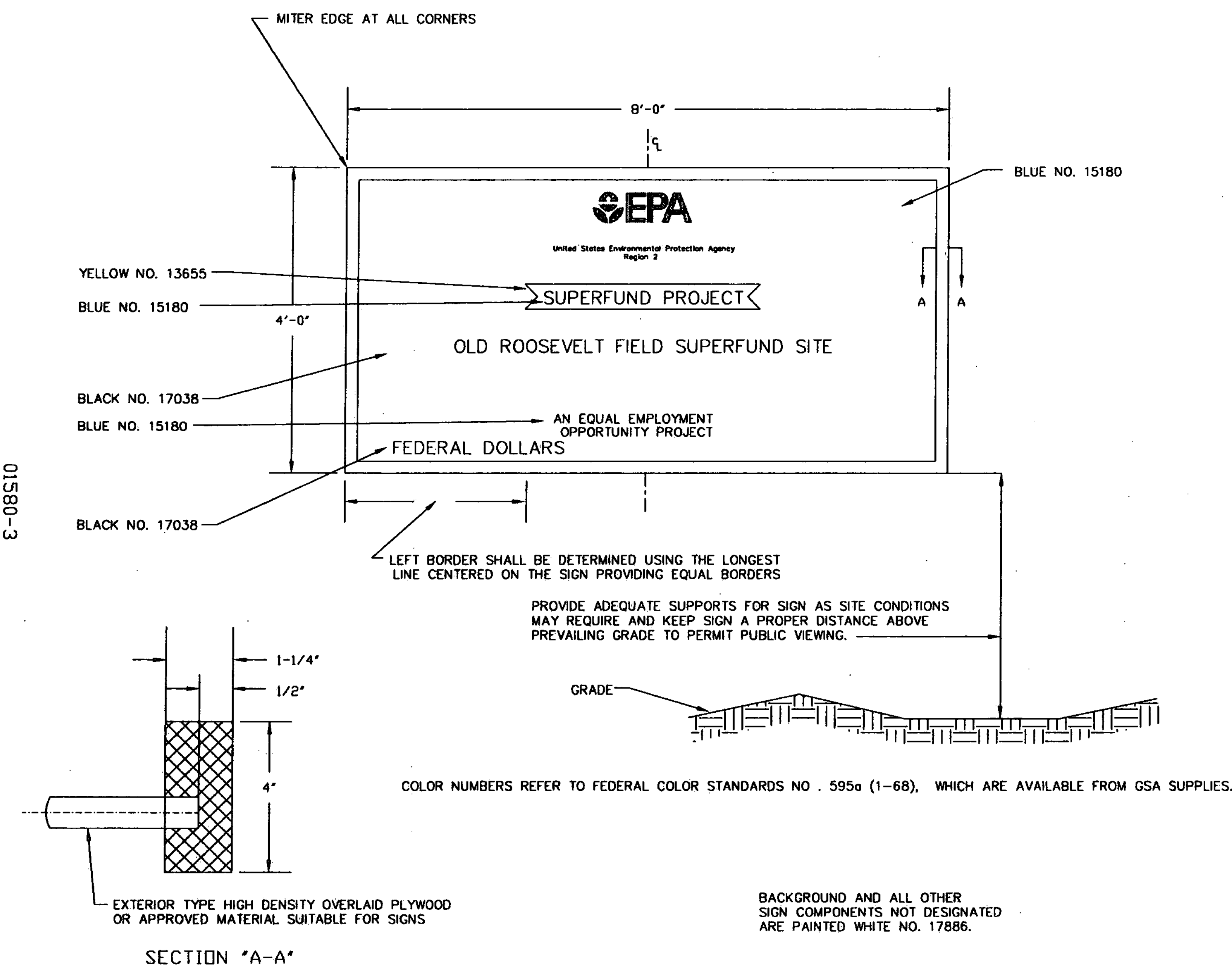
3.3.1 Immediately upon beginning of work, the Contractor shall provide a weatherproof glass-covered bulletin board not less than 36-inches by 48-inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, the Wage Rate Information poster and other information approved by the Engineer. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees, as approved by the Engineer. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work, the bulletin board shall be removed by and remain the property of the Contractor.

3.3.2 The Contractor shall post and keep posted a notice or notices, to be furnished by the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, informing employees of the protections and obligations provided for in the Occupational Safety and Health Act as per OSHA 29 Code of Federal Regulations 1903.2(a)(1). The Contractor shall post such notice or notices in a conspicuous place or places where notices to employees are customarily posted. The Contractor shall take steps to insure that such notices are not altered, defaced, or covered by other material.

3.4 CLOSURE REQUIREMENTS

The bulletin board and the safety signs are to be removed from the site after contract completion or as approved by the Engineer. The USEPA project sign shall be a permanent sign. The project sign installed for the construction activities shall be replaced if damaged during construction as determined by the Engineer. The permanent sign location shall be as directed by the Engineer.

END OF SECTION


MITER EDGE AT ALL CORNERS
8'-0"
BLUE NO. 15180
EPA
United States Environmental Protection Agency
Region 2
YELLOW NO. 13655
BLUE NO. 15180
SUPERFUND PROJECT
4'-0"
A
A
OLD ROOSEVELT FIELD SUPERFUND SITE
BLACK NO. 17038
BLUE NO. 15180
AN EQUAL EMPLOYMENT
OPPORTUNITY PROJECT
FEDERAL DOLLARS
BLACK NO. 17038
LEFT BORDER SHALL BE DETERMINED USING THE LONGEST
LINE CENTERED ON THE SIGN PROVIDING EQUAL BORDERS
PROVIDE ADEQUATE SUPPORTS FOR SIGN AS SITE CONDITIONS
MAY REQUIRE AND KEEP SIGN A PROPER DISTANCE ABOVE
PREVAILING GRADE TO PERMIT PUBLIC VIEWING.
1-1/4"
1/2"
GRADE
4"
COLOR NUMBERS REFER TO FEDERAL COLOR STANDARDS NO . 595a (1-68), WHICH ARE AVAILABLE FROM GSA SUPPLIES.
EXTERIOR TYPE HIGH DENSITY OVERLAID PLYWOOD
OR APPROVED MATERIAL SUITABLE FOR SIGNS
SECTION "A-A"
BACKGROUND AND ALL OTHER
SIGN COMPONENTS NOT DESIGNATED
ARE PAINTED WHITE NO. 17886.

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish all labor, materials, equipment and incidentals required to maintain accurate and comprehensive records of all site activities.

1.1.2 The Contractor shall maintain accurate and comprehensive records of all site activities as well as all additions, substitutions of materials, variations in work and any other revisions to the Contract Documents.

1.1.3 The Contractor shall maintain at the Site for the Engineer or designated representative one record copy suitable for microfilm of:

- Record drawings showing Progress of Work
- Technical Specifications
- Addenda
- Modifications to the Contract
- Engineer's Directives
- Written reports of any significant quality assurance problems
- Daily work activity summary reports, including:

  a) Field test records
  b) Photographs
  c) Reports on any emergency response actions
  d) Reports on all daily site activities
  e) Chain-of-custody documents
  f) Construction schedule and progress chart of work
  g) Change orders and other modifications to the contract
  h) Manufacturer's certificates
  i) Manufacturer's samples
  j) All laboratory analytical results
  k) Meteorological records
  l) All safety and accident reports
  m) All spill incident reports
  n) Daily construction quality control reports
  o) Other items as required by the Engineer

1.1.4 Where appropriate, one copy of all project record documents shall be maintained on compact disc compatible with the Engineer's software.

1.2 MAINTENANCE OF DOCUMENTS

1.2.1 The Contractor shall store record documents and samples in the Contractor's Field Office apart from documents used for construction work.

1.2.2 The Contractor shall provide files and racks for the storage of documents; storage space that can be secured and locked; and a storage area that is clean and dry. Documents and samples should be filed to facilitate retrieval.

1.2.3 Make documents available at all times for inspection by Engineer or designated representative.

1.2.4 The Contractor shall keep up-to-date a complete record set of red-line drawings, which shall be corrected daily to show every change, and the approved shop drawings. This set shall be legibly marked.

1.2.5 The Contractor shall keep up-to-date a complete set of specifications and addenda to record changes made by directive or by change order. This set shall be legibly marked.

1.2.6 The set shall be submitted to the Engineer at the completion of construction.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01780

PROJECT CLOSEOUT

PART 1 GENERAL

1.1 SCOPE OF WORK

This section covers the requirements for final site restoration, inspections, certificates, reports and determinations, and other procedures necessary for contract closeout. Site restoration shall be performed following the successful installation and testing of the components of the extraction and treatment systems, and approval of the Engineer. Restoration work shall consist of removing all equipment not required for operation of the systems, complete decontamination of all such equipment, and performing interim cleanup of the site in preparation for the operation and maintenance of the treatment system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publication is referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

<u>ENVIRONMENTAL PROTECTION AGENCY (EPA)</u>

EPA 540-R-98-016	Close Out Procedures for National Priorities List Sites

1.3 SUBMITTALS

Engineer approval is required for submittals with an "EA" designation; submittals having an "FIO" designation are for information only. The Contractor shall submit the following to the Engineer in accordance with SECTION 01330 – SUBMITTAL PROCEDURES:

1.3.1 Interim Remedial Action (RA) Report; Closeout Submittal; EA

The Contractor shall submit an Interim RA Report in accordance with Paragraph 3.2.5 – Interim RA Report.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SITE RESTORATION

3.1.1 The Contractor shall remove all equipment and materials used during the project operation including, but not limited to temporary site facilities and utilities, project signs, excess construction material or any other vestiges of construction, decontamination pad, etc., prior to demobilization from the site.

3.1.2 All materials removed from the site restoration activities shall be disposed of at an approved off-site disposal facility.

3.1.3 The staging and yard piping area shall be graded to the original conditions and restored as shown on the Contract Drawings.

3.2 ADMINISTRATIVE PROVISIONS

3.2.1 Pre-Final Inspection

The Engineer and the Contractor will conduct a pre-final inspection of the treatment system and restored area in accordance with SECTION 01451 - CONTRACTOR QUALITY CONTROL. The work is considered substantially complete at the time of the pre-final inspection.

3.2.2 Substantial Completion

When the Engineer finds the work to be substantially complete he will prepare a Certificate of Substantial Completion with a list of deficiencies that require timely correction and/or non-construction deficiencies in accordance with provisions of General Conditions.

3.2.3 Operational and Functional (O&F)

Following Substantial Completion, the groundwater treatment system will go through a shakedown period. During this period, the Contractor shall conduct system startup and testing, as required by SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE. At the conclusion of this period and after satisfying the requirements of this paragraph, the determination for commencement of the one-year O&F period will be made by the Engineer.

3.2.4 Final Inspection

Once the system start-up testing is complete, the Engineer and the Contractor will conduct a final inspection of the treatment system and restored area in accordance with SECTION 01451 - CONTRACTOR QUALITY CONTROL. The Engineer will verify that all deficiencies identified during the pre-final inspection have been addressed. The Engineer shall prepare a list of any outstanding deficiencies that require timely correction and/or non-construction deficiencies in accordance with provisions of General Conditions.

3.2.5 Interim RA Report

Following the Operational and Functional (O&F) determination, the Contractor shall prepare and submit an Interim RA report, in accordance with EPA 540-R-98-016.

3.2.6 Final Acceptance:

3.2.6.1 Following the one-year O&F period, a post-final acceptance inspection shall be conducted in accordance with SECTION 01451 - CONTRACTOR QUALITY CONTROL.

3.2.6.2 When the Engineer finds work is complete, he will consider closeout submittals, and a Final Acceptance Certificate will be issued to the Contractor.

3.2.6.3 When the Contractor receives the Final Acceptance Certificate, he shall submit his final invoice for payment.

END OF SECTION

SECTION 01800

TREATMENT SYSTEM OPERATION AND MAINTENANCE

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall operate and maintain the groundwater extraction and treatment system according to the requirements specified herein, the approved Operation and Maintenance (O&M) Manual, and in accordance with applicable provisions of SECTION 01850 - FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND START-UP TRAINING, SECTION 01851 - WELL MAINTENANCE PROGRAM, and SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

1.1.2 The Contractor shall complete startup testing of all treatment and extraction system components. The startup testing shall be done using groundwater.

1.1.3 Following startup testing the Contractor shall commence the operational and functional (O&F) operating period of the treatment system. The O&F operating period will last for one year.

1.1.4 Additional extraction well maintenance requirements are included in SECTION 01851 - WELL MAINTENANCE PROGRAM.

1.2 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The Contractor shall submit the following items in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.2.1 Notification of Maintenance Activities; O&M Data; FIO

Notification shall be made to the Engineer in the event of unscheduled maintenance activities are required.

1.2.2 Monthly Operating Logs; O&M Data; FIO

The Contractor shall submit operating logs to the Engineer on a monthly basis as described in Paragraph 3.5.6.

1.2.3 Initial Testing Program (ITP) Report; Test Reports; FIO

The Contractor shall submit an ITP Report summarizing the results of the baseline monitoring and ITP. The report shall summarize pre-startup conditions for evaluating remedial system progress, and confirm achievement of the remedial system performance requirements.

1.2.4 Quarterly Remedial Progress Reports; Test Reports; FIO

The Contractor shall submit quarterly Remedial Progress Reports as described in Paragraph 3.5.7.

1.2.5 Computerized Recordkeeping System; O&M Data; EA

The Contractor shall provide a computerized record keeping system, which includes scheduled maintenance, equipment lists, etc., along with equipment manufacturer literature and a sample of the output of the record keeping system. The computerized record keeping system shall be approved and operational prior to the startup and operation of the groundwater treatment system.

1.2.6 Optimization Report; Test Reports; FIO

The Contractor shall submit an Optimization Report as described in Paragraph 3.7.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 TESTING OF COMPONENTS AND SYSTEMS

3.1.1 Operational Testing

3.1.1.1 All components of process, mechanical, and electrical equipment, including related piping and control systems, shall be individually inspected and tested by the Contractor in accordance with the requirements of SECTION 13300 - GROUNDWATER TREATMENT SYSTEM, SECTION 13405 - ROCESS INSTRUMENTATION AND CONTROL PRODUCTS, SECTION 13410 - SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM, and SECTION 15200 - PIPING, VALVES, AND APPURTENANCES before the individual components and systems may be put into operation. Testing shall ensure that the equipment has been properly assembled, aligned, adjusted, wired, or connected.

3.1.1.2 Upon completion of the inspection and adjustment or replacement of individual components and systems, the Contractor shall demonstrate that each system of related instrumentation and control equipment operate together in accordance with the contract specifications. If no performance specification is provided, the test shall show that the equipment operated in accordance with normal application practice of the equipment. The testing shall show that the equipment operates free of excessive noise or vibration, that the equipment is responsive to manual and automatic controls, that control and protective devices are properly set, and that the equipment will operate as designed. All alarm systems and safety lockout systems shall be demonstrated for proper function. Testing shall be performed using potable water.

3.1.2 Hydraulic Testing

3.1.2.1 The Contractor shall conduct hydraulic tests on the system once all relevant systems have been documented and accepted by the Engineer as mechanically complete. Operational and hydrostatic testing may be conducted simultaneously. During the testing the Contractor shall inspect all treatment system components, including tanks, pumps, piping, valves, meters, level controls, and connections, to confirm that no system components leak and that all groundwater treatment systems perform correctly.

3.1.2.2 Repair or correct any leaks or other deficiencies observed during the testing. The groundwater treatment system shall be retested after repairs. The hydraulic testing shall not be deemed complete until the entire groundwater treatment system has operated under normal operating conditions without any leaks or other related deficiencies for at least 2 consecutive hours. Water used during such testing shall be discharged to the Nassau County Recharge Basin No. 124.

3.1.2.3 After demonstrating that each system is fully operational, the Contractor shall put the entire facility into operation. The Contractor shall conduct startup testing in accordance with Paragraph 3.2 - System Startup Testing.

3.2 SYSTEM STARTUP TESTING

3.2.1 The Contractor shall conduct an Initial Testing Program (ITP), which shall include two performance tests, 14-day and 48-hour, during this phase of the project and prior to initiating normal plant operation. The 14-day Operational Test is aimed at demonstrating long-term operability of the system while confirming performance expectations with regard to the contaminant removal. The 48-hour Performance Test is intended to rigorously demonstrate performance of the system over a short duration, after mechanical problems have been mitigated as a result of the 14-day test. If the 14-day Operation Test is completed with no significant operational problems as determined by the Engineer, the 48-hour Performance Test shall not be required.

3.2.2 All testing during the ITP shall be performed using groundwater. All groundwater treated during these tests shall be discharged to the recharge basin. During these performance tests the Contractor must demonstrate that the quality of the effluent from the groundwater treatment system does not exceed the limits of the New York State Department of Environmental Conservation (NYSDEC) State Pollution Discharge Elimination System (SPDES) permit equivalency.

3.2.3 Fourteen Day Operational Test

3.2.3.1 The Contractor shall supply all labor, sampling, and analytical services to test the groundwater treatment system during a sustained period of 14 days. Sampling and analytical requirements are shown on Table 01800-1.

3.2.3.2 To meet the requirements of sustained operation, the Contractor must operate the groundwater treatment system 24 hours per day according to the testing requirements specified in Table 01800-1 and as directed by the Engineer for a minimum duration of 14 days. A maximum downtime of 10 percent shall be permitted during the Fourteen Day Operational Test.

3.2.3.3 The Contractor must receive written notification from the Engineer that the 14-day Operational Test was successfully completed before proceeding to the 48-hour Performance Test. If the 14-day Operation Test is completed with no significant operational problems as determined by the Engineer, the 48-hour Performance Test shall not be required.

3.2.3.4 The Contractor shall be responsible for all labor, sampling, and analysis costs due to retest or extensions associated with inability to pass this Performance Test.

3.2.4 48-Hour Performance Test

3.2.4.1 The Contractor shall supply all labor, sampling, and analytical services to test the groundwater treatment system during the period of 48 hours. Sampling and analytical requirements are shown on Table 01800-1.

3.2.4.2 To meet the requirements of sustained operation, the Contractor must operate the groundwater treatment system on a continuous basis for 48 hours using operational settings approved by the Engineer. The system shall operate continuously with no downtime.

3.2.4.3 The Contractor must receive written notification from the Engineer that the 48-hour performance test was successfully completed before commencing the Operational and Functional (O&F) operating period as specified in Paragraph 3.5 - O&F OPERATING PERIOD.

3.2.4.4 The Contractor shall be responsible for all labor, sampling, and analysis costs due to retest or extensions associated with inability to pass this performance test.

3.3 OPERATION OF TREATMENT SYSTEM

3.3.1 General

The Contractor shall operate and maintain the groundwater treatment system during the contract period. The Contractor will be expected to maintain continuous extraction of water from the extraction well at the flow rates designated by the Engineer and continuous treatment of contaminated groundwater.

3.3.2 Sampling and Analysis

The Contractor shall perform all sampling, analysis, and data management in accordance with the Contractor's approved Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) that is to be prepared in accordance with SECTION 01450 - CHEMICAL DATA QUALITY CONTROL. All analytical data shall be provided to the Engineer for evaluation of the groundwater treatment system operation.

3.3.3 Operator's Requirements

3.3.3.1 The Contractor shall have a minimum of two experienced operators with operating experience that satisfy NYSDEC requirements. One operator shall be designated as a backup replacement in the event that the operator responsible for the facility operation is not available. The names and certification of the operator and backup operator shall be provided to the Engineer prior to facility startup. The Contractor shall provide a qualified operator to attend to the proper facility operation and maintenance. The operator shall be present at the facility of not less than 1 day per week. One operator shall be "on call" at all times.

3.3.3.2 The facility operator qualifications shall be in accordance with the requirements of New York State for both water and wastewater treatment plant operation. The qualified operator shall have the capability to respond immediately (within 60 minutes) to any automatic operating alarm or system shutdown that may occur when the facility is unmanned. The operator shall be familiar with the operation of the well extraction system, the groundwater treatment system, and the discharge system.

3.3.3.3 A "Buddy System" shall be utilized whenever maintenance or construction work is being performed at the treatment facility. An additional operator or technician shall accompany the plant operator during all facility maintenance or construction. The "Buddy System" shall be discussed in the Contractor's O&M Plan.

3.3.4 Performance Requirements

3.3.4.1 The Contractor shall operate the groundwater treatment system so that the effluent water quality concentrations do not exceed the NYSDEC/SPDES permit equivalency. If effluent water concentrations for one or more of the parameters exceed the respective effluent discharge limits, the Contractor shall notify the Engineer in writing within 48 hours of the occurrence after receipt of analysis indicating the exceedances. The Contractor shall take immediate and appropriate action to achieve the required effluent concentrations. If that action is outside of the contracted scope of work, then the system shall be shut down pending restart approval from the Engineer.

3.3.4.2 The Contractor shall limit downtime of the treatment system to less than 10 percent during the first year of operation.

3.3.5 Capture Zone Analysis

The Contractor shall submit the water level measurement data as described in Paragraph 3.5.1.1 to the Engineer for evaluation of the extraction wells capture zone to ensure the desired capture zone is being achieved. Engineer will make recommendations as to whether the extraction well flow rate needs to be adjusted to achieve the desired capture zone.

3.4 BASELINE GROUNDWATER MONITORING

3.4.1 Water Levels

3.4.1.1 The Contractor shall conduct baseline groundwater level measurements in the extraction wells and monitoring wells listed in Table 01800-2 to establish baseline conditions prior to startup of the ITP of the groundwater treatment system. Initial water levels in all extraction wells and monitoring wells shall be measured within 4 hours prior to the start of the ITP testing. Groundwater levels for all extraction and monitoring wells shall be measured within a 2-hour time period. The Contractor shall provide means to collect water levels within a 2-hour time period.

3.4.1.2 The reported depth to water shall be measured from the top of the extraction/ monitoring well casing/riser pipe. Groundwater level measurements shall be prepared in table format that includes the date of measurement, time of measurement, depth to water, elevation of the top of the well casing/riser pipe, water level elevation, well pump status (on or off), and flow rate from well.

3.4.2 Groundwater Sampling

As part of the baseline groundwater monitoring program, the Contractor shall collect and analyze the groundwater samples from the wells listed under Table 01800-2, and the extraction wells prior to system startup testing, to establish baseline conditions prior to groundwater treatment system startup.

3.5 O&F OPERATING PERIOD

The Contractor shall prepare and provide Monthly Operating Logs to document events during the O&F period. Operating logs shall include, as a minimum:

- Operator's name and signature
- Date
- Weekly inspection report including, but not limited to, system integrity, vandalism, presence of settling or subsidence, solids buildup, scaling, plugging, or fouling, etc.
- Maintenance recommendations, completed maintenance, or repairs completed
- Operating conditions, including quantities of consumables used, and flow records with flow rates and total flow to the injection wells.
- Any operational problems encountered
- Site visitors
- Shipments received
- Samples submitted for analysis
- Analytical data
- Supply inventory
- Any health and safety activities that occurred or issues that were identified
- Waste disposal quantities and copies of characterization sample results and disposal records/manifests

3.5.1 Groundwater Monitoring

Groundwater monitoring shall be performed by the Contractor in accordance with Table 01800-2. The data/information collected shall be compared against design assumptions and predictions regarding remedy performance, and it shall be used to refine such assumptions and predictions and the environmental monitoring program as more information is gathered.

3.5.1.1 Groundwater Levels

Groundwater levels shall be collected using the same method as specified in Paragraph 3.4.1 - Water Levels. Groundwater levels shall be measured within a 2-hour time period. The Contractor shall provide means to collect water levels within a 2-hour time period.

3.5.1.2 Groundwater Sampling

Groundwater sampling shall be performed in accordance with the Contractor's approved UFP-QAPP and Table 01800-2.

3.5.2 Groundwater Treatment System Sampling and Analysis

3.5.2.1 System Performance Sampling

The Contractor shall collect and analyze samples from influent, intermediate and effluent sample ports from the groundwater treatment system to monitor system performance. Minimum sampling requirements are shown on Table 01800-3.

3.5.2.2 System Compliance Sampling

The Contractor shall collect and analyze the influent (if required) and effluent samples in accordance with NYSDEC SPDES permit equivalency requirements. The NYSDEC SPDES permit equivalent will be obtained by the U.S. Environmental Protection Agency (USEPA) and provided to the Contractor.

3.5.3 System Operations

The contractor shall furnish all labor, equipment, materials, etc. to maintain an operational and functional system. System operations include but are not limited to:

- Operating all equipment, systems, process, and appurtenances in accordance with the contract documents and the approved O&M Manual.
- Extracting and treating groundwater on a continuous basis at a designed flow rate or as specified by the Engineer.
- Containerizing, characterization, transport and dispose of all process and sampling waste residuals at an approved waste disposal facility in accordance with SECTION 02120 – OFFSITE TRANSPORTATION AND DISPOSAL and the approved O&M manual.
- Monitoring treatment system performance, permit compliance, and remedial progress.
- Optimizing of system process to minimize operating costs.
- Maintaining a system uptime of greater than 90%.

3.5.4 Maintenance

3.5.4.1 The Contractor shall notify the Engineer within 24 hours of any unscheduled maintenance required that resulted in downtime of 8 hours or longer for the extraction well or component of the groundwater treatment system.

3.5.4.2 The Contractor shall be responsible for the inspection, preventive maintenance, and unscheduled maintenance of all components of the groundwater, extraction, treatment, and discharge systems for the duration of the Contract in order to maintain a fully operational system.

3.5.4.3 The Contractor shall notify the Engineer of manual shutdown within 24 hours of system shutdown. The length of time for system shutdown shall be minimized to the maximum extent possible.

3.5.4.4 The Contractor shall be responsible for all repairs required to the groundwater treatment system during the Contract period.

3.5.4.5 The Contractor shall maintain the treatment system in a clean condition during the entire operation period and shall thoroughly clean it prior to the end of the Contract period.

3.5.4.6 Extraction well maintenance shall be performed in accordance with SECTION 01851 - WELL MAINTENANCE PROGRAM.

3.5.4.7 Groundwater treatment system maintenance shall be performed by the Contractor to ensure the groundwater treatment system operates as intended. Maintenance items include, but are not limited to:

- Change-out of bag filters
- Cleaning of equalization tank as necessary to prevent solid build-up
- Cleaning of process equipment with acid as often as necessary to prevent plugging, scaling, etc.
- Washdown of process equipment
- Lubrication of process equipment
- Cleanout of process and yard piping

3.5.4.8 The Contractor shall routinely inspect and maintain the physical condition of exterior facilities, equipment, and grounds. The Contractor shall be responsible for maintaining the access road and other features pertinent to the groundwater extraction, treatment and recharge systems. The Contractor shall be responsible for general upkeep and maintenance of the entire Site. Maintenance activities include:

- Maintenance of fencing and locks around the treatment facility
- Maintenance of vegetation around the treatment facility, extraction wells, and monitoring wells
- Maintenance of recharge basin, as necessary or as directed by the Engineer
- Inspection of well vaults for leaks
- Inspection of structural support systems
- Maintenance of building openings and access ways including doors, louvers, fans, and air conditions
- Replacing access road gravel
- Snow removal during winter months

3.5.5 O&F Inspection

The Contractor shall perform, at a minimum, weekly site facility inspections. Additional inspections shall be performed as required.

3.5.6 Monthly Operating Logs

The Contractor shall prepare and provide Monthly Operating Logs to document events during the O&F period. Operating logs shall include, as a minimum:

- Operator's name and signature
- Date
- Weekly inspection report including, but not limited to, system integrity, vandalism, presence of settling or subsidence, solids buildup, scaling, plugging, or fouling, etc.
- Maintenance recommendations, completed maintenance, or repairs completed
- Operating conditions, including quantities of consumables used, and flow records with flow rates and total flow to the injection wells.
- Any operational problems encountered
- Site visitors
- Shipments received
- Samples submitted for analysis
- Analytical data
- Supply inventory
- Any health and safety activities that occurred or issues that were identified
- Waste disposal quantities and copies of characterization sample results and disposal records/manifests

3.5.7 Quarterly Remedial Progress Reports

The Contractor shall prepare Remedial Progress Reports on a quarterly basis. The reports shall include a detailed summary and analysis of remedy performance, including, without limitation:

- Tabulated summary tables for groundwater data and field measurements
- Tabulated summary tables of compliance sampling and monitoring results to demonstrate conformance with the discharge criteria in accordance with NYSDEC SPDES permit equivalent requirements
- Tabulated/graphed summary of groundwater treatment system performance, including average flow rates and cumulative volume of groundwater extraction, and mass removal rates and cumulative mass removed, and percent operational uptime
- Groundwater trichloroethene and tetrachlorethane concentration iso-contour maps
- Graphs for updated groundwater trichloroethene and tetrachlorethane concentration trend analysis

- Tabulated/graphed analysis and interpretation of intrinsic biodegradation data and field measurements
- Written summary, assessment and discussion of remedial action progress for the reporting period
- Recommendations regarding future maintenance activities

3.6 INVENTORY AND SUPPLIES

3.6.5.1 Prior to commencing startup, the Contractor shall provide all supplies necessary for the proper operation of the treatment facility.

3.6.5.2 Spare parts for equipment maintenance shall be supplied by the Contractor as recommended by the equipment vendors.

3.6.5.3 Personal protective equipment (PPE) shall be provided for the groundwater treatment system operators. PPE shall consist of, as a minimum, gloves, respirator, apron, and safety glasses and goggles.

3.6.5.4 The Contractor shall perform a monthly inventory of all supplies.

3.6.5.5 At the conclusion of the Contract, the Contractor shall ensure that all supplies and spare parts are restocked.

3.7 OPTIMIZATION REPORT

The Contractor shall submit a report at the end of the first year operational period. This report shall include recommendations for changes or improvements to the system that will minimize future operational O&M costs. The minimum requirements of this report are as follows: Identify each piece of equipment and provide brief background information on the theory of operation for each piece of equipment. Summarize what variations in operation for each piece of equipment were tried and the results of the variations. The report shall state what parameters were determined to be optimum for each piece of equipment.

3.8 COMPLETION

The Engineer will inspect the operation of the treatment processes and equipment prior to the termination of the Contractor's 1-year operating period to verify that all equipment is in good condition. The Contractor shall restock all supplies and spare parts used during the 1-year operating period. Supplies to be restocked shall include all consumables, spare parts, etc as specified in the Contractor's approved O&M Manual. All supplies shall be replaced to their original quantity and type as required. All equipment used to operate the groundwater treatment system shall remain onsite and become government-owned at the end of the operations period.

END OF SECTION

TABLE 01800-1
Initial Testing Program (ITP) Sampling and Monitoring Schedule

ACTIVITY	LOCATIONS	PARAMETERS[5]	FREQUENCY
14-day Operational Test:			
Step-1, individual well testing [1]			
Water level measurements	Monitoring wells[2]	Water levels	Using data logger
Influent sampling	Influent sample ports	VOC, Total Iron	1 per day (min)
Influent monitoring	Influent sample ports	Water quality parameters[3]	1 per day (min)
	Flow and pressure indicators	Flow, pressure	1 per day (min)
Process sampling	After equalization tank	VOCs, Total Iron	1 per day (min)
	Effluent sample port	Per NYSDEC SPDES permit equivalent requirements [4]	1 per day (min)
Process monitoring	pH indicating transmitter in equalization tank	pH	continuous
	After equalization tank	Water quality parameters[3]	1 per day (min)
	pH indicating transmitter on effluent line	pH	continuous
	Flow and pressure indicators	Flow, pressure	1 per day (min)
Offgas system sampling	Sample port on air stripper offgas effluent line	VOCs via TO-14	1 per day (min)
Optional Testing			
Process sampling	After greensand filtration system, effluent line	Total iron	1 per day (min)
Process monitoring	Flow and pressure indicators on greensand filtration system	Flow, pressure	1 per day (min)
	After greensand filtration system, effluent line	Cl	continuous
Step-2, all three extraction wells in operation			
Water level measurements	Monitoring wells[2]	Water levels	Using data logger
Influent sampling	Influent sample ports	VOC, Total Iron	1 per day (min)
Influent monitoring	Influent sample ports	Water quality parameters[3]	1 per day (min)
	Flow and pressure indicators	Flow, pressure	1 per day (min)
Process sampling	After equalization tank	VOCs, Total Iron	1 per day (min)
	Effluent sample port	Per NYSDEC SPDES permit equivalent requirements [4]	1 per day (min)
Process monitoring	pH indicating transmitter in equalization tank	pH	continuous
	After equalization tank	Water quality parameters[3]	1 per day (min)
	pH indicating transmitter on effluent line	pH	continuous
	Flow and pressure indicators	Flow, pressure	1 per day (min)

TABLE 01800-1
Initial Testing Program (ITP) Sampling and Monitoring Schedule

ACTIVITY	LOCATIONS	PARAMETERS[5]	FREQUENCY
Offgas system sampling	Sample port on air stripper offgas effluent line to roof stack	VOCs via TO-14	1 per week (min)
Offgas system monitoring	The offgas effluent pipe port	VOCs via PID	1 per day (min)
Optional Testing			
Optional process sampling	After greensand filtration system	Total iron	1 per day (min)
	Supernantant in sludge settling tank before being circulated to equalization tank	Total iron	1 per day (min)
	Sludge sample port on the sludge effluent line at the bottom of sludge settling tank	TSS	4 during pumping cycle (min) [6]
Optional process monitoring	Flow and pressure indicators	Flow, pressure	1 per day (min)
	After greensand filtration system, effluent line	Cl	continuous
Disposal sampling	Sludge holding tank	As required by disposal facility	disposal facility
48-hour Operational Test Same as step-2 under 14-day operational test			

NOTES:

1. Groundwater extraction wells EW-1S, EW-1I, and EW-1D are tested individiually at design capacity. Each test will be conducted at a minimum of one day.
2. Well list: GWX-10019, GWX-10020, MW-01(S,I), SVP-10
3. Monitoring parameters: dissolved oxygen, pH, conductivity, temperature, oxidation-reduction potential.
4. As per NYSDEC SPDES permit equivalent requirements.
5. Sample analysis should be conducted in accordance with specification 01451-CHEMICAL DATA QUALITY CONTROL.
6. During the pumping cycle, the sludge at the bottom of the sludge settling tank will be pumped into the sludge holding tank. The Contractor shall collected sludge samples at the beginning and overtime and test for TSS in order to evalutate the quantity of sludge generated duirng each backwash cycle.

min - minimum
NYSDEC - New York State Department of Environmental Conservation
SPDES - State Pollutant Discharge Elimination System
PID - photo-ionization detector
VOCs - volatile organic compounds

TABLE 01800-2
Groundwater Monitoring Program

Well Type	Well ID	Port	Ground Surface Elevation (feet amsl)	Measurement Port Depth (feet BTOC)	Port Elevation (feet amsl)	Quarterly Monitoring (Q1,Q2,Q3) For VOCs	Annual Monitoring (Baseline & Annual) For VOCs	Synoptic Water Level	
								Quarterly	Continuous
Multiport Well	SVP-2	1	89.39	455	-365.6		X	X	
		2	89.39	418	-328.6		X	X	
		3	89.39	378	-288.6		X	X	
		4	89.39	338	-248.6		X	X	
		5	89.39	298	-208.6		X	X	
		6	89.39	258	-168.6		X	X	
		7	89.39	198	-108.6		X	X	
		8	89.39	158	-68.6		X	X	
		9	89.39	108	-18.6		X	X	
		10	89.39	58	31.4			X	
Multiport Well	SVP-3	1	87.17	455	-367.8			X	
		2	87.17	398	-310.8		X	X	
		3	87.17	378	-290.8		X	X	
		4	87.17	298	-210.8		X	X	
		5	87.17	178	-90.8		X	X	
		6	87.17	108	-20.8			X	
		7	87.17	58	29.2			X	
Multiport Well	SVP-4	1	88.85	425	-336.2		X	X	
		2	88.85	405	-316.2	X	X	X	
		3	88.85	358	-269.2	X	X	X	
		4	88.85	313	-224.2	X	X	X	
		5	88.85	293	-204.2	X	X	X	
		6	88.85	253	-164.2	X	X	X	
		7	88.85	193	-104.2	X	X	X	
		8	88.85	153	-64.2		X	X	
		9	88.85	108	-19.2		X	X	
		10	88.85	53	35.9			X	
Multiport Well	SVP-5	1	85.55	435	-349.5		X	X	
		2	85.55	413	-327.5		X	X	
		3	85.55	363	-277.5		X	X	
		4	85.55	318	-232.5		X	X	
		5	85.55	298	-212.5		X	X	
		6	85.55	258	-172.5		X	X	
		7	85.55	198	-112.5		X	X	
		8	85.55	158	-72.5		X	X	
		9	85.55	103	-17.5		X	X	
		10	85.55	53	32.6			X	
Multiport Well	SVP-9	1	89	482	-393.0		X	X	
		2	89	402	-313.0		X	X	
		3	89	352	-263.0		X	X	
		4	89	307	-218.0		X	X	
		5	89	287	-198.0		X	X	
		6	89	247	-158.0		X	X	
		7	89	187	-98.0		X	X	
		8	89	147	-58.0		X	X	
		9	89	102	-13.0		X	X	
		10	89	47	42.0			X	

TABLE 01800-2
Groundwater Monitoring Program

Well Type	Well ID	Port	Ground Surface Elevation (feet amsl)	Measurement Port Depth (feet BTOC)	Port Elevation (feet amsl)	Quarterly Monitoring (Q1,Q2,Q3) For VOCs	Annual Monitoring (Baseline & Annual) For VOCs	Synoptic Water Level Quarterly	Synoptic Water Level Continuous
Multiport Well	SVP-10	1	87	482	-395.0	X		X	
		2	87	402	-315.0	X		X	
		3	87	352	-265.0	X		X	
		4	87	307	-220.0	X		X	
		5	87	287	-200.0	X		X	
		6	87	247	-160.0	X		X	
		7	87	187	-100.0	X		X	
		8	87	147	-60.0		X	X	
		9	87	102	-15.0		X	X	
		10	87	47	40.0			X	
Multiport Well	SVP-11	1	82.5	482	-399.5		X	X	
		2	82.5	402	-319.5		X	X	
		3	82.5	352	-269.5		X	X	
		4	82.5	307	-224.5		X	X	
		5	82.5	287	-204.5		X	X	
		6	82.5	247	-164.5		X	X	
		7	82.5	187	-104.5		X	X	
		8	82.5	147	-64.5		X	X	
		9	82.5	102	-19.5		X	X	
		10	82.5	47	35.5			X	
Regular Monitoring Wells	GWX-10019		85.52	-137.48 to -142.48		X	X		X
	GWX-10020		81.66	-103.34 to -108.34			X		X
	MW-01S			-50		X	X		X
	MW-01I			-225		X	X		X
	MW-02S			-50					X
	MW-02I			-225					X
	MW-03S			-50					X
	MW-03I			-225					X
	EW-1S			-125 to -185					X
	EW-1I			-195 to -255					X
	EW-1D			-265 to -325					X
Multiport Well	SVP-01	All sample ports					See note 1		
	SVP-06	All sample ports					See note 1		
	SVP-07	All sample ports					See note 1		
	SVP-08	All sample ports					See note 1		
	SVP-12	All sample ports					See note 1		
	SVP-13	All sample ports					See note 1		

Notes:
1. Sample will be collected from these four multiport wells duirng the baseline sampling event and every five years afterward.

no sample collection at these ports

amsl - above mean sea level

BTOC - below top of casing

atm. - atmospheric

psi - pounds per square inch

TABLE 01800-3
GWTF Compliance and Performance Monitoring Schedule

ACTIVITY	LOCATIONS	PARAMETERS[3]	FREQUENCY
Influent sampling	Influent sample ports	VOC, Total Iron	As required, monthly (min)
Influent monitoring	Influent sample ports	Water quality parameters[1]	Weekly (min)
	Flow and pressure indicators	Flow, pressure	Weekly (min)
Process sampling	After equalization tank, effluent sample port	VOCs, Total Iron	As required, monthly (min)
Process monitoring	After equalization tank	Water quality parameters[1]	Weekly (min)
	pH indicating transmitter in equalization tank	pH	continueous
	pH indicating transmitter on effluent line	pH	continueous
	Flow and pressure indicators	Flow, pressure	Weekly (min)
Effluent compliance sampling	Effluent sample port	Refer to Note 2	Refer to Note 2
Offgas system sampling	Sample port on air stripper offgas effluent line to roof stack	VOCs via TO-14	Weekly for months 0-6; biweekly for months 6-12
Offgas system monitoring	The offgas effluent pipe port	VOCs via PID	Weekly (min)
Optional Iron Removal System			
Optional process sampling	After greensand filtration system	Total iron	As required, monthly (min)
	Supernantant in sludge settling tank before being circulated to equalization tank	Total iron	As required, monthly (min)
Optional process monitoring	Flow and pressure indicators	Flow, pressure	Weekly (min)
	Chlorine analyzer on effluent line of greensand filters	Chlorine	continueous
Disposal sampling	Sludge holding tank	As required by disposal facility	As required by disposal facility

NOTES:
1. Monitoring parameters: dissolved oxygen, pH, conductivity, temperature, oxidation-reduction potential.
2. As per NYSDEC SPDES permit equivalent requirements.
3. Sample analysis should be conducted in accordance with specification 01451-CHEMICAL DATA QUALITY CONTROL.

GWTF - groundwater treatment facility
NYSDEC - New York State Department of Environmental Conservation
SPDES - State Pollutant Discharge Elimination System
min - minimum
PID - photo-ionization detector
VOCs - volatile organic compounds

SECTION 01850

FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND STARTUP TRAINING

PART 1 GENERAL

1.1 SCOPE OF WORK

This section covers requirements for the development of a system Operations and Maintenance (O&M) Manual and startup training requirements of the Contractor personnel for the operation and maintenance of the groundwater extraction, treatment and discharge system.

1.2 REFERENCES

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the following references, the revision in effect at the time of contract award shall apply.

U. S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA-430/9-74-001 Considerations for Preparation of Operation and Maintenance Manuals

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The Contractor shall submit the following items in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 System O&M Manual; O&M Data; EA

Prior to start-up, the Contractor shall submit an O&M Manual for equipment that will be operated and maintained as a part of the groundwater treatment system. The O&M Manual shall describe the procedure for testing, operating and maintaining the groundwater treatment system to accomplish the required treatment as detailed in Paragraph 1.4 - O&M MANUAL. The Draft O&M Manual shall be submitted 2 months prior to startup of the facility for approval. Facility startup shall not commence until the O&M Manual has been approved by the Engineer. The Final O&M Manual shall be submittal within 60 days of system startup.

1.3.2 User Startup Training and Instruction Schedule; Pre-Construction Submittal; EA

The Contractor shall submit proposed user startup training and instruction schedule 2 months prior to the scheduled startup of the groundwater treatment system.

1.3.3 Proposed Changes to the O&M Manual; O&M Data; EA

The Contractor shall submit all proposed changes to the O&M Manual for approval.

1.4 O&M MANUAL

The Contractor shall prepare an O&M Manual for the extraction, collection and recharge of groundwater and the treatment plant operations. The O&M Manual shall include general system descriptions, locations, emergency procedures, startup procedures, normal operation, shutdown procedures, and scheduled and unscheduled maintenance for each system. In addition, the O&M Manual shall include a master equipment list (MEL), as-built drawings, equipment manufacturer's startup, operation and maintenance manuals for all equipment, warranty listings, and a list of recommended spare parts for each system. Each volume shall have an index of all major items in the volume.

The operation portion of the manual shall include a general overview section for each system, as well as startup, normal operations, and shutdown procedures for each system. Process and instrumentation diagrams (P&IDs), instrumentation and control set points, and alarm conditions shall be provided for each system. The manual shall also contain any emergency procedures. The O&M Manual shall, as a minimum, contain the following information, which is described in the following sections:

- General Information
- Theory of Operation
- Startup Procedures
- Operating Procedures
- Shutdown Procedures
- Safety Procedures
- Emergency Procedures and Emergency Contact List
- Sampling and field measurement requirements
- Laboratory Testing Requirements
- Maintenance Requirements
- Recommended Special Tools and Equipment List
- Master Equipment List (shall be implemented on the computerized system)
- Spare Parts Data List (shall be implemented on the computerized system)
- Equipment Vendor Data Index (shall be implemented on the computerized system)
- Staffing Requirements
- Regulatory Requirements
- Record Keeping Requirements
- Manufacturers Warrantees

1.4.1 General Information and Description

This chapter shall be prepared for supervisory personnel and other users having a general interest in the system to determine its purpose, physical and functional characteristics, and operational capabilities easily and rapidly. This section shall generally include:

- Operational and managerial responsibilities

- A description of the system/subsystem purpose, scope, and function
- References to assembly and detail drawings that are essential to support the manual
- A summary of major system components

1.4.2 Theory of Operation

A description of the theory of operation shall be provided to the extent necessary for journeyman understanding. An overall analysis of the principles of operation and functions, such as control interlocks shall be included. Instrumentation and control set points and alarm conditions shall be included.

1.4.3 Startup Procedures

These procedures shall present a step-by-step sequence of events to be performed upon startup of the systems in the O&M Manual. Steps necessary to bring the equipment from OFF through STANDBY conditions to operation shall be described in a command response table and shall include identifying nomenclature and numbers.

1.4.4 Operating Procedures

1.4.4.1 Operating procedures shall include the sequencing of tasks required to maintain daily operation of the facility. Included in these procedures shall be any data logging or verification requirements for each system. The operating procedures shall be preceded by complete equipment operation safety precaution descriptions. Reference shall be made to supplier or manufacturer's recommended operation procedures as presented in catalog material. This material shall be included in the final version of the O&M Manual.

1.4.4.2 Operating procedures shall also provide step-by-step command/response procedures describing connection of test equipment, testing procedures, test results, and tolerances. Reference to appropriate trouble analysis or repair instructions to correct or adjust faulty equipment shall be provided. Descriptions of controls, indicators, and protective devices shall be presented using illustrations/photos, diagrams, and drawings to provide the following:

- Names of panel designations marked on the equipment.
- Positions and operating functions for each control and the normal operating condition of each indicator in each operating function.

1.4.5 Shutdown Procedures

These procedures shall include all steps necessary to bring the equipment from ON operation through STANDBY to OFF conditions. Procedures and actions required to shutdown and secure the equipment or system shall be presented in command-and-response narrative.

1.4.6 Safety

The Contractor shall incorporate a section within the O&M Manual devoted to the maintenance of a safe working environment. Typical preventative maintenance activities should be detailed, and special considerations relating to individual process equipment should be developed and incorporated.

1.4.7 Emergency Procedures and Emergency Contact List

This procedure shall cover turning the equipment OFF during an emergency condition (such as fire, water, smoke, hazard to personnel, or loss of normal power) when different from NORMAL shutdown.

1.4.8 Sampling and Field Measurement Requirements

The Contractor shall identify sampling and field measurement requirements and procedures in accordance with SECTION 01450 - CHEMICAL DATA QUALITY CONTROL and SECTION 01800 – TREATMENT SYSTEM OPERATION AND MAINTENANCE.

1.4.9 Laboratory Testing Requirements

The Contractor shall identify laboratory testing requirements and procedures in accordance with SECTION 01450 - CHEMICAL DATA QUALITY CONTROL and SECTION 01800 – TREATMENT SYSTEM OPERATION AND MAINTENANCE.

1.4.10 Maintenance Procedures

The Contractor shall establish a computerized equipment preventive maintenance management system that shall serve as a log of routine maintenance, provide information for solving continuing maintenance problems, and to record data for preparing cost analysis and facility usage records. Routine, preventative and corrective procedures for all system components shall include but not be limited to: groundwater extraction well and pump; process equipment, electrical equipment, instrumentation, valves and appurtenances; yard piping; general building maintenance; recharge basin maintenance; and exterior facilities (vegetation, fencing, etc.).

1.4.10.1 Preventive maintenance

Preventive maintenance procedures shall be prepared for periodic inspection and servicing, lubrication, alignment, calibration, and adjustment events normally encountered, and shall be based on extracts from manufacturer and vendor data. Maintenance records shall assist in identifying day-to-day maintenance that must be completed, as well as providing information on past maintenance practices such as adjustment and repairs, and shall also provide quick access to information such as model numbers, parts lists, service representatives, etc., to assist in the ordering of replacement parts. The preventative maintenance procedures should also list frequency and maintenance action, and shall include a lubrication program. This schedule shall be maintained on the computerized record keeping system.

1.4.10.2 Corrective maintenance

System and subsystem step-by-step in-place corrective repair procedures shall be provided for equipment based on extracts from manufacturer and vendor data. This section shall include the following components:

- Trouble-shooting procedures
- Wiring diagrams and control diagrams
- Maintenance and repair procedures
- Removal and replacement instructions
- A record system to document the work completed

1.4.11 Recommended Special Tools and Test Equipment List

A recommended special tools and test equipment list shall be prepared for each system and subsystem. This list shall include equipment nomenclature, manufacturer name, part number, characteristics, and application. The list shall include the identification of necessary associated equipment and handling equipment required for the removal and reinstallation of replaceable parts. Each item listed shall be referenced in the vendor data when possible.

1.4.12 Master Equipment List

Contractor shall include the applicable master equipment list for each system, subsystem, and component in the O&M Manual. This list shall also be implemented on the computerized system.

1.4.13 Spare Parts List

The Contractor shall provide recommended spare parts lists necessary to support normal operation in the O&M Manual. The spare parts list that shall include those parts recommended for 1 year period of long-term response operation following expiration of the warranty period. A list of all part numbers by specific nomenclature arranged in alphanumeric order shall be provided. References to the applicable repair parts list, figure, manual, procurement lead time, estimated unit price, and inventory code shall be included as applicable. This system shall also be tracked on the computerized system.

1.4.14 Manufacturer's Index

An alphanumeric index of manufacturers, listing names and addresses and cross-referencing identifying symbols, shall be provided. Where applicable, the true source of supply/ manufacturer shall be identified by code, name, and address.

1.4.15 Equipment Vendor Data List

The Contractor shall provide a complete listing of all materials suppliers for operator reference. This list shall be maintained on the computerized recordkeeping system.

1.4.16 Staffing

The Contractor shall provide recommendation for staffing the facility and for back-up operator in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE. Qualifications, including state-required certification, shall be identified. A job description shall be prepared for the facility operator. The staff organization, with managerial responsibilities and staff responsibilities, shall be described.

1.4.17 Regulatory Requirements

The Contractor shall identify pertinent state and/or federal environmental regulatory requirements that must be adhered to during the facility operation. A list of permits and their requirements shall be included and referenced. The agency name, telephone number, and address shall be provided for reference purposes.

1.4.18 Record Keeping

A computerized record keeping system shall be operational prior to the treatment plant startup and shall be incorporated during the operation period. The Contractor shall establish a records management system as related to process control, facility usage, testing procedures, influent and effluent quality monitoring, reporting requirements, and inventories. This system shall include the following: Monthly Operating Reports, Operating Cost Records, Maintenance Cost Records, Monthly Operating Logs, and Analytical Results. The system shall include records of Preventive Maintenance, Repair and Maintenance, master equipment list, Repair Parts Data List, Equipment Vendor Data, Regulatory Requirements, Record keeping, and analytical results. The Contractor shall furnish the appropriate personal computer system and software of sufficient capacity for use with the computerized record keeping system.

1.4.19 Manufacturers Warrantees

Copies of manufacturers' warrantees for all system equipment shall be included in the O&M Manual.

PART 2 PRODUCTS (not used)

PART 3 EXECUTION

3.1 USER STARTUP TRAINING AND INSTRUCTION

The training shall consist of at least 40 hours of instruction including both onsite and classroom activities and shall include training in the startup, daily O&M, and troubleshooting of the extraction, treatment plant, and discharge systems. The training, as a minimum, shall include operator familiarity with the startup, operating, and shutdown procedures developed in accordance with this specification and review of all available equipment vendor data. The Engineer will designate the personnel to be trained. The Contractor shall provide operator training for all software provided under this contract. Additional training requirements are included in the respective equipment specification sections.

3.2 TRAINING SCHEDULE

The Contractor shall provide formal training at the end of the one year operational and functional (O&F) period to the incoming groundwater treatment system operator's staff within the final 45 calendar days. The training session shall be completed not less than 20 calendar days before the contract expires. The Contractor shall prepare an outline of the proposed training schedule for review by the Engineer. Coordination with the Engineer shall commence a minimum of 14 calendar days prior to commencement of the training. Revisions to the training schedule will be communicated to the Engineer a minimum of 7 calendar days prior to the beginning of the training period.

END OF SECTION

SECTION 01851

WELL MAINTENANCE PROGRAM

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall be responsible for implementing a Well Maintenance Program for all extraction and monitoring wells. The well maintenance program shall guard against the deterioration of performance, as determined by decreases in the pumping rates or significant decreases in specific capacities of extraction wells, during the contract period. Significant decrease in specific capacity is any decrease equal to or greater than a specified percentage of the original stipulated values, as specified by the Engineer.

1.1.2 The Contractor shall propose methods to be used in monitoring and maintaining the extraction and monitoring well performance in the Operation and Maintenance Manual submitted under SECTION 01850 - FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND STARTUP TRAINING. Mechanical surging and pumping, chemical treatment, high pressure jetting techniques are acceptable methods for re-developing the extraction wells. The O&M Manual shall stipulate monitoring frequency and frequency of data tabulation and reporting.

1.2 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.2.1 Chemical Additives and Agents; Product Data; EA

Chemical additives and agents other than as specified in Paragraph 2.1 shall be approved by the Engineer prior to its use for well cleaning.

1.2.2 Extraction Well Testing Results; Test Report; FIO

1.2.2.1 Proposed extraction/monitoring well maintenance activities, proposed extraction/monitoring well testing to determine cause of lost capacity, and proposed changes to the well maintenance program shall be submitted in accordance with SECTION 01850 - FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND STARTUP TRAINING.

1.2.2.2 Results of the well maintenance program shall be included in the Weekly and Monthly Operating Logs and Remedial Progress Reports as specified in SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE.

PART 2 PRODUCTS

2.1 ACIDS

Mineral encrustation and/or biofouling caused by iron bacteria are two common reasons for well failure. Two acids commonly used to treat wells that have failed due to these reasons are:

2.1.1 Hydroxyacetic Acid - shall be 70 percent concentration. It shall exhibit iron bactericide properties and inhibitors to reduce corrosion to stainless steel casing and well screen.

2.1.2 Sulfamic Acid - shall be 70 percent concentration. It shall be inhibited to reduce metallic corrosion of stainless steel screen well casing and well screen.

2.2 OTHER ADDITIVES

Additional chemical additives and proprietary agents (such as chlorinators, surfactants, wetting agents, inhibitors, neutralizers, and dechlorinators) shall be submitted for approval by the Engineer prior to their use. Corrosion inhibitors shall be used with acid to prevent deterioration of the well screen. Only polyelectrolyte wetting agents shall be approved. All additives must be nutrient and phosphate free.

PART 3 EXECUTION

3.1 The Contractor shall implement a well maintenance program, in accordance with the approved O&M manual, if significant decreases in the pumping rates or well-specific capacities are observed. Should a significant decrease in well-specific capacity be observed in a well, the Contractor shall investigate and diagnose the cause of the lost capacity and perform the corrective measures necessary to rehabilitate the well. Investigation testing of the well shall be done by an approved method. These results shall be used to select and implement the approved well maintenance activities.

3.2 Significant decrease in specific capacity is any decrease greater than or equal to 25 percent for extraction wells of the original stipulated values as specified by the Engineer, based on results of the extraction well step testing. Any decrease in flow rate below the approved rate shall be considered significant. The Contractor shall perform well maintenance within 30 days of the initial determination that the specific capacity had declined by the specified percent or more, or if the approved flow rate is not being maintained.

3.3 Biofouling from iron bacteria is a common inhibitor of well performance. If biofouling from iron bacteria is suspected as the cause of the reduced capacity, the following procedures shall be implemented:

3.3.1 Record the pumping rate and the water level of the well.

3.3.2 Turn the well off and allow the groundwater surface to recover to within 90 percent of static water level.

3.3.3 Remove piping, pump, and other equipment, clean to remove fouling or encrustation.

3.3.4 Estimate the specific capacity of the well (well flowrate/pumping drawdown).

3.3.5 Calculate the total volume to be treated (3 times the volume of standing water in the well casing).

3.3.6 Treat the well with the hydroxyacetic acid product following the procedures recommended by the manufacturer.

3.3.7 Pump, to waste, the volume to be treated. Waste shall be temporarily stored onsite. The waste shall be pretreated (e.g., increase the pH) and disposed off site in accordance with SECTON 02120 - OFFSITE TRANSPORTATION AND DISPOSAL.

3.3.8 Return pump to service and determine the new specific capacity of the well. If this value has not improved by 10 percent, repeat steps specified in Paragraphs 3.3.1 through 3.3.7.

3.4 Chemical and mineralogical incrustation is also major causes of well failure. If incrustation is suspected to be the cause of reduced capacity, the following procedure shall be implemented:

3.4.1 Follow steps specified in Paragraphs 3.3.1 through 3.3.5.

3.4.2 Treat the well with the sulfamic acid product following the procedures recommended by the manufacturer.

3.4.3 Pump, to waste, the volume to be treated. Waste shall be temporarily stored onsite. The waste shall be pretreated (e.g., increase the pH) and disposed off site in accordance with SECTON 02120 - OFFSITE TRANSPORTATION AND DISPOSAL.

3.4.4 Return pump to service and determine the new specific capacity of the well. If this value has not improved by 10 percent, repeat steps in Paragraphs 3.4.1 through 3.4.3.

3.5 If biofouling and encrustation are identified to be the cause of the reduced yield, the well may be treated with treatment chemicals simultaneously if recommended by the manufacturer.

3.6 Other causes of decreased well performance may occur. If one of the above treatments is not applicable for treating the fouling cause identified by the Contractor, a proposed alternative shall be submitted for approval by the Engineer.

END OF SECTION

SECTION 02100

SITE PREPARATION

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, materials and equipment required to perform all site preparation activities as specified herein and presented on the Contract Drawings.

1.1.2 The Contractor shall obtain all permits required for site preparation work prior to proceeding with the work. All local permit requirements shall be coordinated in advance with the Engineer.

1.1.3 Prior to performing any site preparation activities, the Contractor shall document existing site conditions via photographs, in accordance with SECTION 01380 - PROJECT PHOTOGRAPHS, and shall report in writing to the Engineer prior to the commencement of any site preparation work. The Contractor shall also field verify the existing site conditions in accordance with SECTION 01550 - SURVEYING. Any significant difference between the assumed existing conditions and actual conditions at the time of construction shall be discussed with the Engineer prior to the work.

1.1.4 The Contractor shall coordinate with property owner prior to performing work presented on the Contract Drawings and as required to complete the work.

1.1.5 The Contractor shall contact the local authority or utility companies to mark out the utilities and protect the utilities, such as light pole, sewer, storm sewer, phone, electrical, water main to the extent possible.

1.1.6 The Contractor shall ensure that all work is performed safely in accordance with the safety requirements of SECTION 01351 - SAFETY, HEALTH, AND EMERGENCY RESPONSE

1.2 REFERENCES

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

<u>AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)</u>

ASTM C 33	Standard Specification for Concrete Aggregates
ASTM D 4491	Water Permeability of Geotextile by Permittivity
ASTM D 4632	Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	Determining Apparent Opening Size of a Geotextile

ASTM D4833	Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
ASTM D 5199	Measuring Normal Thickness of Geotextiles and Geomembranes
ASTM D 5261	Measuring Mass per Unit Area of Geotextiles

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The Contractor shall submit the following to the Engineer in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Site Preparation Plan; Pre-Construction Submittals; EA

Site Preparation Plan shall be submitted at least 30 calendar days prior to mobilization for Engineer approval. The Site Preparation Plan shall address in detail all the work listed under PART 3.0 of this specification.

1.3.2 Crushed Stone Aggregate Certificates of Compliance; Certificates; FIO

The Contractor shall submit to the Engineer certificates of compliance, furnished by the crushed stone facilities, stating the physical properties of the crushed stone to be used onsite meet the specification requirements as described in Paragraph 2.1 – CRUSHED STONE AGGREGATE.

1.3.3 Geotextile Filter Fabric Certificates of Compliance; Certificates; FIO

The Contractor shall submit to the Engineer certificates of compliance, furnished by the geotextile fabric manufacturer or supplier, stating the physical properties of the geotextile fabric to be used onsite meet the specification requirements as described in Paragraph 2.2 – GEOTEXTILE FABRIC

1.3.4 Permits; Certificates; FIO

Copies of all permits obtained not submitted under other sections.

PART 2 PRODUCTS

2.1 CRUSHED STONE AGGREGATE

Crushed stone shall be sound, hard, and durable and shall meet the following gradation requirements and shall conform to ASTM C 33 Size No. 57.

U.S. Sieve Size	Percent Finer by Weight
1-½ inch	100
1-inch	95-100
½-inch	25-60
No. 4	0-10
No. 8	0-5

2.2 GEOTEXTILE FABRIC

The geotextile fabric shall be a nonwoven fabric consisting only of continuous chain polymer filaments or yarns of polyester, formed into a stable network by needle punching. The fabric shall be mildew and rot resistant. The fabric shall contain the properties listed in Table 02100-1.

Table 02100-1
Fabric Properties

Fabric Property	*Test Method*	*Minimal Physical Properties*
Fabric Weight	ASTM D 5261	8.0 oz/yd^3
Fabric Thickness	ASTM D 5199	105 mils
Grab Strength	ASTM D 4632	230 lbs
Puncture Resistance	ASTM D 4833	100 lbs
Water Flow Rate	ASTM D 4491	90 gpm/ft^2
Permeability, K	ASTM D 4491	0.34 cm/sec
AOS	ASTM D 4751	Sieve Size 70

PART 3 EXECUTION

3.1 STAGING AREA AND DECONTAMINATION FACILITIES

3.1.1 The staging area shall be constructed at the location shown on the Contract Drawings and in accordance with SECTION 01500 - TEMPORARY CONSTRUCTION FACILITIES. The crushed stone shall be underlain by geotextile filter fabric meeting the requirements of Paragraph 2.1 and 2.2, respectively.

3.1.2 The decontamination facilities shall be constructed at approved locations in accordance with SECTION 01351 – SAFETY, HEALTH AND EMERGENCY RESPONSE. The design of the decontamination facility submittal is included under SECTION 01500 – TEMPORARY CONSTRUCTION FACILITIES AND UTILITIES as a part of Temporary Site Facility Layout Plan.

3.2 CLEARING AND GRUBBING

3.2.1 The Contractor shall cut and remove all timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish and any other objectionable material resting on or protruding through the surface of the ground, as required to complete construction. All such work required beyond the required limits shall be subject to approval by the Engineer. Any limbs and branches to be trimmed nearby the excavation or staging area shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree- wound paint. Trees and vegetation designated to remain shall be protected from damage incident to clearing, grubbing, demolition, and construction operations, in accordance with the requirements of Paragraph 3.4 – PROTECTION.

3.2.2 Trees shall be felled in such a manner as to avoid damage to trees left standing, the nearby fence, and with due regard for the safety of employees and others.

3.2.3 The Contractor shall grub and remove all stumps, roots in excess of 1½ inches in diameter, matted roots, brush, timber, logs, concrete rubble and other debris encountered to a depth of 18 inches below original grade or 18 inches beneath the bottom of foundations, whichever is deeper.

3.2.4 The Contractor shall refill all grubbing holes and depressions excavated below the original ground surface with suitable materials and compact to the surrounding ground surface.

3.3 DEMOLITION

3.3.1 Existing site features shall be demolished or removed from the construction areas to complete construction work. Items requiring demolition shall be subject to approval by the Engineer.

3.3.2 Existing concrete and asphalt shall be saw cut along the outer edges of such sections requiring removal.

3.3.3 The Contractor shall employ water sprays for work during demolition operations as required to prevent dust from becoming airborne. Use of water shall be minimized to prevent runoff and accumulation of wastewater.

3.4 PROTECTION

3.4.1 Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.4.2 Utility poles and subsurface utilities designated by the Engineer shall be protected during remedial action by erecting suitable barriers, guards and enclosures, or by other approved means.

3.4.3 The Contractor shall repair all damage to trees, shrubs, and plants scheduled to remain, by properly dressing, cutting and painting, or replace those items that cannot be repaired.

3.4.4 The Contractor shall seed all grassed areas, beyond the limits of construction shown on the Contract Drawings, which have been damaged as a result of the Contractor's operation.

3.4.5 The Contractor shall not destroy or damage trees and shrubs outside the limits of construction, without the authorization of the Engineer.

3.5 DISPOSAL

3.5.1 Stripped topsoil, grass, cut tree trunks and limbs, and grubbed material shall be considered uncontaminated and shall be disposed in accordance with SECTION 02120 – OFFSITE TRANSPORTATION AND DISPOSAL.

3.5.2 Burning of cleared and grubbed materials or other fires for any reason will not be permitted.

3.5.3 The pavement shall be recycled or disposed of at an approved landfill.

3.5.4 The Contractor shall be responsible for all wastes until they are accepted by the recycling or disposal facilities. It is the Contractor's responsibility to ensure that all waste shipments are in compliance with the recyclable or disposal facility's requirements at the time of receipt of the shipments at the appropriate facilities. No rubbish or debris of any kind shall be buried on the project site.

END OF SECTION

SECTION 02120

OFFSITE TRANSPORTATION AND DISPOSAL

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, materials, equipment and incidentals necessary for offsite transportation and disposal of waste materials. Waste materials refer to any and all materials including, but not limited to, excess excavated soil left after grading, construction debris, drill cuttings, drilling fluids, sediment from well development, and sludge removed during construction and operation of iron removal system. The Contractor's plans, which will be based on the requirements of this section, shall provide the detailed methods for performing the work.

1.1.2 The Contractor shall characterize all waste in accordance with the sample requirements and methodology included in the Contractor's approved Uniform Federal Policy Quality Assurance Project Plan and as required by the offsite disposal facilities.

1.1.3 The Contractor shall ensure that all operations for loading and hauling of wastes are in compliance with Federal, State, and local regulations.

1.1.4 All contaminated water produced from well development and well testing activities shall be treated and discharged to the local storm sewer in accordance with SECTION 02525 – WELL INSTALLATION AND TESTING.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

<u>AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)</u>

ASTM D 1117	Standard Guide for Evaluating Non-woven Fabrics

<u>CODE OF FEDERAL REGULATIONS (CFR)</u>

29 CFR 1904, 1910 and 1926	Occupational Safety and Health Administration (OSHA) Standards
40 CFR 262	Regulations for Hazardous Waste Generators
40 CFR 263	Regulations for Hazardous Waste Transporters
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan

49 CFR 100-179	Hazardous Material Transportation Act
49 CFR 173	Shippers - General Requirements for Shipment and Packaging
49 CFR 178	Specifications For Packaging

FEDERAL RESOURCE CONSERVATION AND RECOVERY ACT (RCRA).

Public Law 94-580

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA OSWER Directive No. 9834.11

NEW YORK STATE CONSERVATION CODE OF RULES AND REGULATIONS (NYCRR)

6 NYCRR - Chapter IV, Subchapter B	Solid Wastes

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC)

NYSDEC, Part 371.4	List of Hazardous Wastes.

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Transportation Plan; Pre-Construction Submittal; EA

The Contractor shall prepare and submit to the Engineer for approval a Transportation Plan which shall include the proposed truck routing from the Old Roosevelt Field Superfund Site to the disposal site. The route to and from the disposal facility shall be in accordance with both local and disposal facility requirements and shall be approved by the Village of Garden City prior to commencing work. The Plan shall also cover all aspects and considerations for waste transportation hazards that will be involved during hauling operations. The plan shall include, but not be limited to, the following: procedures for incident response, methods to contain and clean up spills, details of manpower and equipment available and the coordination necessary to mobilize forces in an emergency. Response shall be implemented within one hour following any accident or release of contaminated material, as directed by the Engineer and at the Contractor's expense. The plan shall also include a list of the types of materials to be transported, the types of transport vehicles to be used for each type of material, and the packaging and transporting requirements for each type of waste including any special requirements of the disposal facility.

1.3.2 Notice of Non-Compliance and Notice of Violation; Product Data; FIO

Notice of non-compliance or notices of violation by a federal, state or local regulatory agency issued to the Contractor in relation to any work performed under this contract. The Contractor shall immediately provide copies of such notices to the Engineer. The Contractor shall also furnish all relevant documents regarding the incident and any information requested by the Engineer, and shall coordinate its response to the notice with the Engineer or his designated representative prior to submission to the notifying authority. The Contractor shall also furnish a copy to the Engineer of all documents submitted to the regulatory authority, including final reply to the notice, and all other materials, until the matter is resolved.

1.3.3 Transport Certification; Certificates; FIO

The Contractor shall submit certification that all operators and vehicles used to transport contaminated material meet all existing federal, state and local regulations for vehicle operations.

1.3.4 Annual and Biennial Reports; Test Reports; EA

Information necessary to file State annual or EPA biennial reports for waste transported or disposed of under this contract shall be submitted to the Engineer at the specified time and shall not be forwarded directly to the regulatory agency. The submittal shall contain all the information necessary for filing of the formal reports in the form and format required by the governing Federal, State and local regulatory agency. A cover letter shall accompany the data including the contract number, Contractor name and project locations.

1.3.5 Shipping Documents and Packaging Certification; Certificates; EA

All transportation related shipping documents shall be submitted to the Engineer, including draft waste manifests, draft bills of lading, lists of corresponding proposed labels, packages, marks, and placards to be used for shipment, waste profiles, supporting waste analysis documents, for review a minimum of 14 calendar days prior to the anticipated shipping date. Packaging assurances shall be furnished prior to transporting the material, "generator copies" of hazardous waste manifests, bill of landings, and supporting waste analysis documents shall be furnished when shipments are originated.

1.3.6 EPA Off-Site Policy; Certificates; FIO

A letter certifying that EPA considers the facilities to be used for all off-site disposal to be acceptable in accordance with the Off-Site policy in 40 CFR 300.440. This certification shall be provided for wastes from RCRA, 42 U.S.C. 6901 et seq., sites as well as from Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 42 U.S.C. 9601 et seq., responses. See Attachment A, sample certification, at the end of this section.

1.3.7 Certificates of Disposal; Certificates; FIO

Certificates documenting the ultimate disposal of wastes within 180 calendar days of initial shipment. Receipt of these certificates will be required for final payment.

1.3.8 Disposal Facility Names and Permits; Pre-Construction Submittals; EA

The Contractor shall submit the name and permits of the disposal facilities to the Engineer for approval. A primary and an alternative facility shall be provided for all types of waste expected to be generated.

1.4 PERMIT REQUIREMENTS

The Contractor shall be responsible for obtaining any and all permits required for offsite transportation of waste in accordance with applicable Federal, State and local regulations.

1.5 LAWS AND REGULATORY REQUIREMENTS

Work shall meet or exceed the minimum requirements established by Federal, State, and local laws and regulations which are applicable. These requirements are amended frequently and the Contractor shall be responsible for complying with amendments as they become effective. In the event that the compliance exceeds the scope of work or conflicts with specific requirements of the contract, the Contractor shall notify the Engineer immediately. At a minimum the requirements, stipulated in the regulations referenced in Paragraph 1.2 - References shall be met.

PART 2 PRODUCTS

2.1 CONTAINERS

2.1.1 Shipping Containers

Impermeable containers shall be suitable to receive and retain contaminated materials until they are disposed of at an approved facility. The containers shall meet the standards of a "Strong, Tight Container" and conform to 49 CFR 173.24. Containers in a shipment must be loaded and braced securely to prevent shifting and damage during transport. Cover systems shall meet the criteria for a closed transport vehicle as specified in 49 CFR 173.403.

2.1.2 Drums

All drums shall be DOT 17H or 17E and in accordance with state regulations.

2.2 LABELING

The Contractor shall provide primary and subsidiary labels for materials/wastes consistent with the Federal, State and local requirements. Labels shall be durable and weather resistant and capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

2.3 PLACARDS

For each off-site shipment of materials/wastes, the Contractor shall provide primary and subsidiary placards as required by Federal, State and local regulations. Placards shall be provided for each side and each end of bulk packaging, and transport vehicles requiring such placarding.

Placards may be plastic, metal, or other material capable of withstanding, without deterioration, a 30 day exposure to open weather conditions.

2.4 TARPAULINS

Waterproof tarpaulins shall be nylon vinyl-coated on both sides with a tearing strength of 70 lbs conforming to ASTM D 1117, or equal. All edges shall be hemmed, with reinforced grommets on maximum 4 feet on centers.

2.5 SPILL RESPONSE MATERIALS

The Contractor shall provide spill control materials and equipment which are sufficient to meet the requirements described in SECTION 01351 - SAFETY, HEALTH AND EMERGENCY RESPONSE.

2.6 EQUIPMENT AND TOOLS

The Contractor shall provide miscellaneous equipment and tools necessary to handle hazardous materials and hazardous wastes in a safe and environmentally sound manner.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 The Contractor shall ensure that all transport vehicles containing waste be covered with tarps before leaving the site.

3.1.2 The Contractor shall coordinate the schedule for vehicle arrival and material deliveries at the construction site to meet the approved project schedule. The schedule shall be compatible with the availability of equipment and personnel for material handling operations. No claims shall be made by the Contractor for additional compensation due to a delay in the schedule related to vehicle arrival or material availability.

3.1.3 The Contractor shall organize and maintain the material shipment records required by the Federal and the State of New York regulations.

3.1.4 The Contractor is responsible for obtaining and filling out waste profile sheets required by the disposal facility. The quantity of sheets per contained waste shall be in accordance with Federal, State or local regulations. The Contractor shall submit each profile sheet to the Engineer.

3.1.5 The Contractor shall utilize transporters having proper EPA identification numbers and NYSDEC hauler registrations, and shall assure through the manifest system that the waste arrives at the authorized offsite disposal facility. The Contractor shall report to the Engineer any shipments that do not reach the disposal facility.

3.1.6 The Contractor shall notify the Engineer immediately upon learning that a job related accident has occurred. Notification of the accident shall include location of the accident, resultant damage or injury, person(s) involved, probable cause, amount of waste spilled, and any other pertinent information concerning the accident.

3.1.7 Accident cleanup operations shall be performed as directed by the Engineer at the expense of the Contractor. Cleanup shall be performed immediately.

3.1.8 The Contractor shall provide transportation of the waste directly to the disposal facility.

3.1.9 The Contractor shall provide all sampling and analytical services necessary for disposal in accordance with disposal facility requirements, and all applicable Federal, State, and local regulations.

3.2 SEGREGATION OF WASTE MATERIALS

3.2.1 The Contractor shall be responsible for segregating all wastes generated as a result of construction and operation activities. Waste materials shall be segregated, at a minimum, as potentially hazardous waste and non-hazardous waste. Wastes from each process shall be containerized separately so as to containerize like waste streams. All waste characterization sampling and field screening methods shall be in accordance with disposal facility requirements and applicable Federal, state and local regulations.

3.2.2 All drill cuttings, sediment, and solid wastes in contact with contaminated groundwater shall be segregated and sampled for determination of hazardous or non-hazardous waste classification.

3.2.3 Wastewater from equipment decontamination, well development, and other sources mixed with contaminated groundwater shall be segregated and sampled for waste classification as hazardous or non-hazardous waste.

3.2.4 Personal protective equipment (PPE), packaging and shipping materials, construction and demolition debris, excess excavated soil and other materials not in contact with contaminated groundwater shall be segregated as non-hazardous. Wastewater from routine maintenance of treatment facilities and other sources not mixed with contaminated groundwater shall be segregated as non-hazardous.

3.3 WASTE HANDLING

3.3.1 Solid Waste

3.3.1.1 Solid waste material shall be stockpiled and covered or loaded into roll-off containers or 55-gallon drums using a loading system approved by the Contractor. The roll-off containers or drums shall be loaded in such a manner as to prevent the spreading of contaminated material to uncontaminated areas. Drums shall be secured tight prior to transport to temporary storage area.

3.3.1.2 Temporary stockpiles shall be small and manageable and shall be covered with plastic sheeting, or equivalent material to protect waste from adverse weather conditions and to prevent dust emissions. Erosion and sedimentation controls shall be installed around all stockpiles.

3.3.1.3 The filled roll-off containers or drums shall be placed on impermeable layer or polyethylene sheeting or equivalent material and shall be stored in a manner that will prevent puncture and accidental release prior to shipment off site. Handling of hazardous waste shall be kept to a minimum.

3.3.1.4 Onsite transportation vehicles for contaminated waste shall be appropriate for conditions such that contaminated waste will not be released or spilled during transit.

3.3.2 Contaminated Water

3.3.2.1 All contaminated water shall be containerized in a manner that prevents accidental spills and releases. This shall include, but not be limited to, ensuring that contaminated water containers remain closed when not in use. HDPE tanks or 20,000-gallon (e.g., Baker) tank shall be used to containerize the contaminated water from the well development activities prior to onsite treatment and discharge as described in SECTION 02525 - WELL INSTALLATION AND TESTING. Treated effluent will be tested prior to sewer discharge to ensure that it meets the established discharge criteria.

3.3.2.2 The Contractor shall construct a temporary storage area for containerized contaminated water, as appropriate, using plastic sheeting and other materials necessary to prevent accidental spills or releases.

3.4 WASTE LOADING AND VEHICLE INSPECTION

3.4.1 The Contractor shall provide equipment that is appropriate to accomplish this type of work and shall maintain and use of it in strict compliance with Occupational Safety and Health Administration (OSHA) requirements. The Contractor shall take all necessary precautions for safe operation of the equipment and the protection of the public from injury and damage from such equipment.

3.4.2 Vehicles may be inspected by the Engineer at the site prior to loading to ensure that the vehicles have no fluids leaks, no unusually noisy mufflers or tailpipes, tires that are in good condition, and operational brakes, horn, steering, operating controls, and safety devices. Vehicles shall be free of excess dirt, debris, oil, grease, and excessive rust. Vehicle beds used for hauling shall be free from drain holes, cracks, or other conditions that might permit waste material or contaminated water to leak from the vehicle beds. If the vehicle used for hauling has tailgates for dumping, the Contractor shall demonstrate to the Engineer that the tailgates can be sealed watertight during operation. Any vehicle bed not providing an adequate leakproof seal shall be repaired or replaced as required. Tarpaulin covers shall be placed over all vehicle beds during waste transport to the disposal facility. Covers shall be placed over trucks, trailers or other conveyances used for bulk shipment to avoid spillage of the waste material and entrance of rain or snow during transport. The covers shall completely enclose the bulk shipment with no open areas along the sides or openings on the top. Cover systems shall meet the criteria for a closed transport vehicle as specified in 49 CFR 173.403(c). Failure of the shipping container, liner, seals, hatches, doors, or tarpaulin system to meet the above requirements which causes material to be rejected by disposal facility shall be addressed at the Contractor's expense.

3.4.3 The Contractor shall coordinate recording quantities of waste leaving the site with the Engineer.

3.4.4 Vehicles/containers, either empty or loaded, shall not remain at the site, unless specific arrangements are made otherwise. Immediately after loading, they shall be sealed, weighed and transported directly to the disposal facility.

3.4.5 The Contractor shall provide clean containers/hauling vehicles for loading during normal work hours.

3.5 TRANSPORTATION

3.5.1 The Contractor shall meet all existing Federal, State, and local regulations for vehicle operations in transporting the waste on public roads and highways. All haul and access roads shall be maintained in a clean condition so that no dirt or contamination is tracked onto clean areas or public roads and highways.

3.5.2 The Contractor shall be responsible for any and all actions necessary to remedy situations involving material spilled in transit on or off site or mud and dust tracked off site. This cleanup shall be accomplished at the Contractor's expense.

3.5.3 Transportation routes to and from project areas shall be in accordance with the approved Transportation Plan. No deviation from transportation routes shall be allowed without prior written approval from the Engineer.

3.5.4 The Contractor shall be responsible for all repair costs for damages to structures, roads, bridges and any other features affected by the Contractor's offsite transportation and disposal operations.

3.6 OFFSITE DISPOSAL

3.6.1 The Contractor shall dispose of all waste at an approved off-site disposal facility. The Contractor shall be responsible of coordinating the proposed modes of transportation and scheduling and notification of all shipments with the disposal facility. The Contractor shall notify the Engineer in writing within 14 calendar days of any problems or issues which occur during transportation to the disposal location. This notification shall include any damage to containers during transportation and any scheduling conflicts with the disposal subcontractor which may adversely impact project schedule or cost.

3.6.2 The Contractor shall provide for the weighing of each loaded container by a certified weigh-master at a State-certified scale at the disposal facility. Shipping documentation shall be faxed to the Engineer immediately after each load container is weighed. The Contractor shall provide the Engineer with an original copy of the shipping documentation within five days following shipment.

3.6.3 The Contractor shall be responsible for all wastes until they are accepted by the disposal facility. It is the Contractor's responsibility to ensure that all waste shipments are in compliance with the disposal facility's requirements at the time of receipt of the shipments at the disposal facility.

3.6.4 The Contractor shall maintain communication throughout the transportation process associated with each shipment to ensure adequate notification of scheduled arrival times for containers reaching the site. The Contractor shall be responsible for all delays in turnaround time for transport vehicles.

3.7 EPA ID NUMBERS

The EPA Region II will provide waste generator identification number for use on the manifest.

3.8 RECORDKEEPING

The Contractor shall be responsible for maintaining adequate records to support information provided to the Engineer regarding exception reports, annual reports and biennial reports.

3.8.1 The Contractor shall provide all supporting documentation for manifest preparation and bill of lading to the Engineer. The documentation shall be prepared, reviewed and approved by an authorized representative of the Contractor and shall be in accordance with 40 CFR 262 Subpart B and 40 CFR 263 Subpart B, Territory requirements, and the requirements of the state or Territory where the disposal facility is located, if applicable. The Contractor shall obtain manifest forms, obtain material code numbers and complete the shipment manifest records as required by the appropriate regulatory agencies for verifying the material type and quantity of each load in unit of volume and weight. The Contractor shall certify all manifests and shipping documentation for waste disposal in a format and language similar to that found on a standard manifest form. Copies of each manifest shall be submitted to the Engineer within two days following shipment and within two days after notification of receipt at the permitted disposal facility. Any manifest discrepancies shall be reported immediately to the Engineer and resolved by the Contractor. A detailed report documenting the final disposal of all materials removed from the site shall be submitted to the Engineer

3.9 SPILL RESPONSE

The Contractor shall respond to any spill of contaminated material which is in custody or care of the Contractor, pursuant to this contract in accordance with SECTION 01351 - HEALTH, SAFETY, AND EMERGENCY RESPONSE.

3.10 EMERGENCY CONTACTS

3.10.1 The Contractor shall be responsible for complying with the emergency contact provisions in 49 CFR 172, Section 604. Whenever the Contractor ships hazardous materials, the Contractor shall provide a 24-hour, 7-day a week monitoring telephone service emergency response contact. The person must be knowledgeable about the hazardous materials being shipped and who has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information.

3.10.2 The phone must be monitored on a 24 hour basis at all times when the hazardous materials are in transportation, including during storage incidental to transportation.

3.10.3 The Contractor shall ensure that information regarding this emergency contact and phone number are placed on all hazardous material shipping documents. The Contractor shall designate an emergency coordinator and post the following information at areas in which hazardous wastes are managed:

- Emergency coordinator's name
- Emergency coordinator's phone number
- Local fire department phone number
- Fire extinguishers and spill control materials location

Attachment A

SAMPLE OFF-SITE POLICY CERTIFICATION MEMO

Project/Contract #:____________________________________
Waste Stream:____
Primary TSD Facility, EPA ID # and Location: ____________________
Alter. TSD Facility, EPA ID # and Location:______________________

EPA Region	Contact
I	(617) 918-1752
II	(212) 637-4130
III	(214) 814-5267
IV	(404) 562-8591
V	(312) 353-8207
VI	(214) 665-2282
VII	(913) 551-7154
VIII	(303) 312-6419
IX	(415) 972-3304
X	(206) 553-2859

EPA representative contacted: ______________________________
EPA representative phone number: __________________________
Date contacted: ____

Comment: ____
The above EPA representative was contacted on ____________. As of that date the above sites were considered acceptable in accordance with the Off-Site Policy in 40 CFR 300.440.

Signature: __________________________ Date: ____________________

Phone number: ____

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, materials, equipment, and incidentals required to perform excavation for building foundation and well vaults; trenching for pipelines and appurtenances; backfilling and compaction; and disposal of surplus material.

1.1.2 Excavation for structures, such as building foundation, vault, etc., shall be completed to the width and depth shown on the Contractor's approved drawing. Excavation for pipe trench shall be completed to the width and depth shown on the Contract Drawings and shall provide suitable room for installing pipe, and appurtenances.

1.1.3 All excavation and trenching shall comply with the requirements of Occupational Safety and Health Administration (OSHA) excavation safety standards as specified in 29 CFR Part 1926.650 Subpart P and all applicable Federal, State and local laws, regulations, and requirements.

1.1.4 Dust control measures shall be employed as required to prevent dust from becoming airborne during earthwork activities.

1.1.5 Prior to the start of work, the Contractor shall submit the proposed method of excavation, backfilling and compaction to the Engineer.

1.1.6 Prior to performing any trenching activities, the Contractor shall contact the Village of Garden City and Nassau County to obtain the proper permit and contact local utilities to mark out all underground utilities. The locations of utility lines are approximate on the Contract Drawings and shall be field verified by the Contractor prior to any excavation. Prior to any excavation work, utility clearances shall be documented with a completed Field Safety Checklist.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the below standards, the revision in effect at the time of contract award shall apply.

<u>CODE OF FEDERAL REGULATION (CFR)</u>

29 CFR 1926, Subpart P	Safety and Health Regulations for Construction - Subpart P: Excavations, Sections 650-652

<u>AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)</u>

ASTM D 421	Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants

ASTM D 422	Particle-Size Analysis of Soils
ASTM D 698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
ASTM D 1556	Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4972	Standard Test Method for pH of Soils
ASTM D 5268	Standard Specification for Topsoil Used for Landscaping Purposes

NEW YORK STATE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATION (NYSDOTSS)

Section 200	Earthwork
Section 713	Landscape Development Materials

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Excavation, Trenching and Backfill Plan; Pre-Construction Submittals; EA

Submit to the Engineer the proposed methods of construction, including excavation, trenching, backfilling and compaction for the various portions of the work. The Contractor shall remain responsible for adequacy and safety of construction means, methods, and techniques.

1.3.2 Laboratory and Field Test Results; Test Reports; FIO

The Contractor shall submit the results of all laboratory and field testing, as specified in Paragraph 3.8 – Soil Testing, to the Engineer within 24 hours of their receipt/ completion. These shall include the results of all chemical testing, sieve analyses performed, in-place density testing, moisture-density testing, and all other testing performed of backfill/topsoil materials and compaction requirements.

1.3.3 Earthen Materials Certificates of Compliance; Certificates; FIO

The Contractor shall submit to the Engineer certificates of compliance, furnished by the borrow material source facilities, stating the physical and chemical properties of the earthen materials to be used onsite, indicating their conformance to the requirements specified herein. Certificates shall be provided for all materials included in Part 2 - Products.

1.4 QUALITY ASSURANCE

The Contractor shall coordinate with the soils testing laboratory to verify the suitability of the existing subgrade soil at all structures and to perform in-place soil density tests as required to verify that the bearing capacity of the subgrade is sufficient. The Contractor shall coordinate with the soils testing laboratory to perform in-place soil density tests to verify that all backfill material has been compacted in accordance with the compaction requirements specified elsewhere. The Engineer may designate areas to be tested.

PART 2 PRODUCTS

2.1 WASHED SAND

Washed Sand shall consist of washed coarse sand having the following gradation by weight:

Sieve Size	Percent Finer by Weight
3/8"	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

2.2 TOPSOIL

Topsoil shall meet the requirements of NYSDOTSS Section 713 and/or ASTM D 5268. Topsoil material shall not contain slag, cinders, stones, lumps, roots, plant parts, trash, or similar objects larger than 1.5-inch in any dimension and shall have the pH value of the material between 5.5 and 7.6. Topsoil material shall have a minimum organic content of 2.0 percent by weight. Topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Certificates of compliance for the above parameters shall be provided from the source facility and submitted to the Engineer. If certificates are not available for any parameter, the Contractor shall be responsible for providing soil testing to determine the material. The testing shall determine whether any soil amendments are required to meet the growing requirements of the seed and other landscaping features to be used.

2.3 SCREENED GRAVEL

Screened gravel shall consist of hard, durable rounded particles of proper size and gradation, free from sand, loam, clay excess fines and deleterious materials. The size of the particles shall be uniformly graded gravel such that not less than 95 percent of the particles will pass a 3/4-inch sieve and not more than 5 percent will pass a 3/8-inch sieve.

PART 3 EXECUTION

3.1 TEST PITS

3.1.1 Excavation of test pits may be required for the purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.

3.1.2 Test pits shall be backfilled as soon as the desired information has been obtained. The backfilled surface shall be maintained in a satisfactory condition for travel until resurfaced as specified.

3.2 TRENCH EXCAVATION PROCEDURES

3.2.1 Trench excavation shall include material of every description and of whatever substance encountered, except rock. Pavement shall be cut with a saw, wheel or pneumatic chisel along straight lines before excavating.

3.2.2 Strip and stockpile topsoil from grassed areas crossed by trenches. At the Contractor's option, topsoil may be otherwise disposed of and replaced, when required, with approved topsoil of equal quality.

3.2.3 While excavating and backfilling is in progress, traffic shall be maintained, and all utilities and other property protected as provided in the General Conditions and General Requirements.

3.2.4 Trenches shall be excavated to the depth indicated on the Contract Drawings and in widths sufficient for laying the pipe and bracing. The bottom of the excavations shall be firm and dry and in all respects acceptable to the Engineer. Trench width shall be practical minimum.

3.2.5 Excavation shall be accomplished by methods that preserve the undisturbed state of subgrade soils. The trench may be excavated by machinery to, or just below the designated subgrade, provided that material remaining in the bottom of the trench is no more than slightly disturbed.

3.2.6 Clay and organic silt soils are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, the Contractor shall use a smooth-edge bucket to excavate the last 1 foot of depth.

3.2.7 Where pipe is to be laid in washed sand bedding, the trench may be excavated by machinery to the normal depth of the pipe provided that the material remaining in the bottom of the trench is no more than slightly disturbed.

3.2.8 Where pipe is to be laid directly on the trench bottom, final excavation at the bottom of the trench shall be performed manually, providing uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing.

3.3 STRUCTURAL EXCAVATION PROCEDURES

3.3.1 Excavations for structures, including building foundation, well vaults, junction boxes, pull boxes, and appurtenances shall be suitably wide and deep for construction of the structures, including excavation supports and working clearances.

3.3.2 Excavation shall be performed in-the-dry and shall be accomplished by methods that preserve the undisturbed state of subgrade soils.

3.3.3 Subgrade Preparation

3.3.3.1 The Contractor shall prepare subgrade for all structures unless otherwise shown on the approved drawings or otherwise specified herein:

3.3.3.2 After completion of excavation, the Contractor shall compact the top 12 inches of subgrade to a minimum of 95 percent standard Proctor (ASTM D698).

3.3.3.3 Where existing subgrade contains a significant amount of clay or cohesive soils, the Contractor shall over-excavate sufficiently below the bottom of structure for placement of a lean concrete working mat. Prior to placing the lean concrete working mat, the Contractor shall compact the top 12 inches of existing subgrade to a minimum of 95 percent standard Proctor (ASTM D698).

3.3.4 When excavations have reached the required subgrade, including any allowances for working mats or base materials, prior to the placement of working mats or base materials, the Contractor shall notify the soils testing laboratory to verify the suitability of the existing subgrade soils for the anticipated structural loadings. If the existing subgrade soils are determined to be unsuitable, direction will be provided by the Engineer regarding removal and replacement with suitable materials. If the Contractor believes that such direction would increase its cost and would thereby entitle it to a change in Contract cost, the Contractor shall notify the Engineer in accordance with the applicable article(s) in the General Conditions pertaining to changes in the work.

3.3.5 Over-excavation beyond the limits and depths required by the Contract Documents shall be replaced at no additional cost to the Government by lean concrete, structural fill, or other approved material subject to the prior approval of the Engineer.

3.4 HANDLING AND DISPOSAL OF EXCAVATED SOIL

3.4.1 Excavated material shall be stacked without excessive surcharge on the trench bank. Inconvenience to traffic and abutters shall be avoided as much as possible. Excavated material shall be used to backfill on different parts of the work as required.

3.4.2 It is expressly understood that no excavated material shall be removed from the site of the work or disposed of, except as directed by the Engineer. Excavated material surplus shall be disposed of in accordance with SECTION 02120 - OFFSITE TRANSPORATION AND DISPOSAL.

3.4.3 Should conditions make it impracticable or unsafe to stack material adjacent to the trench, the material shall be hauled and stockpiled at an approved location. When required, it shall be re-handled and used in backfilling the trench. Soil stockpiles shall be maintained according to the Contractor's approved Soil Erosion and Sediment Control Plan.

3.5 BACKFILLING AND COMPACTION

3.5.1 General

3.5.1.1 Backfill material shall consist of excavated material or select granular material as specified herein. Backfill materials shall be placed in lifts to suit the specified compaction requirements to the lines and grades required, making allowances for settlement and placement of cover materials (i.e., topsoil, sod, etc.). Soft spots or uncompacted areas shall be corrected.

3.5.1.2 Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for under pavement and sidewalks and 90 percent maximum density backfill in the municipal park and washed sand at or near its optimum moisture content (minus 2 to plus 3 percent) as determined by ASTM D698 (Standard Proctor), unless otherwise specified. The Contractor shall ensure that all foundation subbase is compacted to at least 95 percent maximum density. Compaction testing shall be performed as specified in Paragraph 3.8 – Soil Testing.

3.5.1.3 Backfill materials shall not be placed on frozen surfaces, or surfaces covered by snow or ice. Backfill material shall be free of snow, ice, and frozen earth. Backfill shall not be placed and compacted when the materials are too wet to properly compact (i.e., the in-place moisture content of the soil at that time is no more than three percentage points above the optimum moisture content of that soil as determined by the laboratory test of the moisture-density relation appropriate to the specified level of compaction).

3.5.2 Trench Backfill

3.5.2.1 As soon as practicable after the pipe has been laid and jointed, backfilling shall begin and thereafter be executed expeditiously. Bedding sand, specified above as washed sand and as shown on the Contract Drawings, shall be placed as shown on the Contract Drawings. Trenches shall be backfilled to the grade shown on the Contract Drawings.

3.5.2.2 To prevent longitudinal movement of the pipe, dumping backfill material into the trench and then spreading will not be permitted until bedding material has been placed and compacted as shown on the Contract Drawings.

3.5.2.3 Backfill shall be brought up evenly on all sides. Each layer of backfill material shall be thoroughly compacted by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench.

3.5.2.4 Where other methods are not practicable, compaction shall be by use of hand or pneumatic ramming with tools weighing at least 20 lb. The material shall be spread and compacted in layers not over 6 inches thick. If necessary, sprinkling shall be employed in conjunction with rolling or ramming.

3.5.2.5 Backfill around structures shall be compacted by puddling where approved by the Engineer. All backfill shall be compacted, especially under and over the pipes connected to the structure.

3.5.2.6 Subject to the approval of the Engineer, fragments of ledge and boulders smaller than 6 inches may be used in trench backfill providing that the quantity in the opinion of the Engineer is not excessive. Rock fragments shall not be placed until the pipe has at least 2 feet of earth cover. Small stones and rocks shall be placed in thin layers alternating with earth to ensure that all voids are completely filled. Fill shall not be dropped into the trench in a manner to endanger the pipe.

3.5.2.7 Bituminous paving shall not be placed in backfilling unless approved by the Engineer. Frozen material shall not be used under any circumstances.

3.5.3 Structural Area Backfilling

3.5.3.1 Compaction in structural or access road may be accomplished by any of the following methods: compaction equipment, fully loaded 10 wheel trucks, tractor bulldozers weighing at least 30,000 lbs. and operated at full speed, or heavy vibratory rollers. Compaction in areas where the use of large equipment is impractical, shall be accomplished by hand operated vibratory equipment or mechanical tampers. Lift thickness shall not exceed 6 inches (measured before compaction) when hand operated equipment is used.

3.5.3.2 Screened gravel as specified above shall be placed as a capillary water barrier under concrete floors and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of hand-operated, plate-type, vibratory compactor. The thickness of the barrier shall be 6 inches. To prevent loss of barrier permeability during concrete placement, a 10 mil PVC plastic membrane (vapor barrier) shall be used to cover the compacted screened gravel.

3.6 TRENCH RESTORATION

Trench surfaces shall be restored as specified herein and as shown on the Contract Drawings.

Where the trench occurs adjacent to parking lots and sidewalks, the Contractor shall thoroughly consolidate the backfill and maintain the surface as the work progress. If settlement takes place, immediately deposit additional fill to restore the level of the ground.

3.7 SPREADING TOPSOIL

In areas to be restored with grass it shall be covered with a minimum topsoil thickness of 6 inches. The surface shall be free of materials that would hinder planting or maintenance operations. The subgrade shall be pulverized to a depth of 2 inches by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to the thickness, elevations, and slopes shown, and left free of surface irregularities. Topsoil shall be compacted by one pass of a cultipacker, roller, or equivalent. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

3.8 SOIL TESTING

3.8.1 Testing shall be performed by an approved commercial testing laboratory. The Contractor shall submit to the Engineer licenses or certifications of qualification for the performance of field and laboratory testing in accordance with the approved UFP-QAPP.

3.8.2 Topsoil Testing: Prior to the use of any topsoil on site, the Contractor shall meet the testing requirements specified in Paragraph 2.2.

3.8.3 Sieve Analysis: Sieve analysis shall be performed in accordance with ASTM D 421 and ASTM D 422. A minimum retest for classification shall be performed every 3000 cubic yards.

3.8.4 Density Testing: Field in-place density tests shall be determined in accordance with ASTM D 2922. A minimum of one test shall be performed per 200 linear feet of backfilled trench and per 500 cubic yards of material placed for building, with no less than one test per lift. Calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922, Paragraph Standardization and Reference Check. ASTM D 2922 results in a wet unit weight of soil and, when using this method, ASTM D 3017 shall be used to determine the in place moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of each working day and for each different type of material encountered. Calibration for in-place density shall consist of determining in-place density test in accordance with ASTM D 1556.

3.8.5 Moisture-Density Test: A moisture-density relationship for the soil shall be determined in accordance with ASTM D 698 (Standard Proctor). A minimum of one test per 5,000 cubic yards shall be performed, but no less than one test per borrow area. The Engineer may direct additional tests should soil materials change during the course of work.

3.9 GRADING

The Contractor shall uniformly smooth and grade all filled areas to provide a finished surface that is reasonably smooth, compacted to the specified project requirements, free from irregular surface changes, and sloped to drain properly. Grading shall not create swales or areas where ponding of water will occur. After grading is completed and accepted by the Engineer, no further filling or grading shall be permitted except with the approval of and inspection by the Engineer.

3.10 SOIL EROSION AND SEDIMENT CONTROLS

All work shall be protected from erosion by installing soil erosion and sediment controls, in accordance with the Contractor's approved Soil Erosion and Sediment Control Plan as specified in SECTION 02370 - SOIL SURFACE EROSION CONTROL.

END OF SECTION

SECTION 02370

SOIL EROSION CONTROL

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to prepare a Soil and Sediment Erosion control Plan, and perform erosion and sediment control as necessary for the duration of the project. Work shall be performed as shown on the Contract Drawings, specified herein and identified in the Contractor's approved Soil Erosion and Sediment Control Plan.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

<u>AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)</u>

ASTM D751 Coated Fabrics

ASTM D4632 Grab Breaking Load and Elongation of Geotextiles

ASTM D3786 Bursting Strength of Textile Fabric

<u>NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC)</u>

"New York Standards and Specifications for Erosion and Sediment Control" (August, 2005)

<u>NEW YORK STATE DEPARTMENT OF TRANSPORTATION</u>

New York State Department of Transportation Standard Specifications (NYSDOTSS) - Section 209: Temporary Soil Erosion and Sediment Control

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Soil Erosion and Sediment Control Plan; Pre-Construction Submittals; EA

The Contractor shall prepare and submit a Soil Erosion and Sediment Control Plan for Engineer approval. Subsequent to the approval of the Plan by the Engineer, the Contractor shall submit the Plan to the Nassau County Soil and Water Conservation District for additional required approvals.

1.3.2 Samples; Samples; EA

Samples of all materials shall be submitted for inspection and approval upon the Engineer's request.

1.3.3 Permits; Certificates; FIO

The Contractor shall be responsible for acquiring all permits from the Nassau County Soil and Water Conservation District and NYSDEC prior to construction.

PART 2 PRODUCTS

2.1 TEMPORARY SEEDING AND MULCHING

Temporary seeding and mulching are measures consisting of seeding, mulching, fertilizing, and placing matting utilized to reduce erosion. All cut and fill slopes shall be seeded when and where necessary to prevent or eliminate erosion.

2.2 BALED HAY OR STRAW CHECKS

2.2.1 Baled hay or straw erosion checks are temporary measures to control erosion and prevent siltation. Bales shall be either hay or straw containing 5 cubic feet or more of material.

2.2.2 Baled hay or straw checks shall be used where the existing ground slopes toward or away from an embankment, along the toe of slopes, in ditches, or other areas where siltation, erosion or water runoff are problems.

2.3 TEMPORARY SILT FENCES

The siltation fence fabric shall be a geotextile material suitable for siltation control use. The minimum tensile strength shall be 90 pounds, meeting ASTM D1682. Wood posts will be of sound quality hardwood with a minimum cross sectional area of 3.0 square inches and the minimum height of the posts shall be 36 inches. Steel posts will be standard T and U section weighing not less than 1.00 pound per linear foot. The fence shall be a minimum of 16 inches in height and the distance shall be at a maximum of 10 feet on center.

2.4 GEOTEXTILE FABRIC

The geotextile fabric shall be a nonwoven fabric consisting only of continuous chain polymer filaments or yarns of polyester, formed into a stable network by needle punching. The fabric shall be mildew and rot resistant. The fabric shall contain the properties listed in Table 02370-1.

Table 02370-1
Fabric Properties

Fabric Property	Test Method	Minimal Physical Properties
Grab Tensile Strength	ASTM D4632	90 lbs
Elongation at Failure	ASTM D4632	50%
Mullen Burst Strength	ASTM D3786	190 psi
Puncture Strength	ASTM D751	40 lbs
Slurry Flow Rate		0.3 gal/min/sf
Equivalent Opening Size	US Std Sieve CW-02215	40-80

PART 3 EXECUTION

3.1 SILTATION AND EROSION CONTROL

3.1.1 Siltation and erosion control practices shall be consistent with procedures outlined in the NYSDEC Standards and Specifications for Erosion and Sediment Control and the Contractors approved Plan.

3.1.2 If the Contractor desires to stockpile construction materials such as stone, earth, etc., the location of these materials and the protection measures required shall be outlined in the Soil Erosion and Sediment Control Plan to be submitted to the Engineer for approval.

3.2 CONSTRUCTION REQUIREMENTS

3.2.1 The Engineer has the authority to direct the Contractor to provide immediate, permanent, or temporary pollution control measures to prevent contamination migrating outside the work zone. Such work may involve the use of temporary mulches, mats, or other control devices or methods as necessary to control erosion.

3.2.2 The Contractor shall be required to incorporate all erosion control features into the project at the earliest practicable time as outlined in its accepted schedule. Temporary pollution control measures shall be used to correct conditions that develop during construction, that are needed prior to installation of permanent pollution control features, or that are needed temporarily to control erosion that develops during normal construction practices.

3.2.3 In the event of conflict between these requirements and pollution control laws, rules or regulations, or other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

3.3 CONSTRUCTION OF CONTROL MEASURES

3.3.1 Baled Hay or Straw Erosion Checks

Hay or straw erosion checks shall be embedded in the ground 4 to 6 inches to prevent water from flowing under them. The bales shall also be anchored securely to the ground, as shown on the Contract Drawings. Bales shall be removed after they have served their purpose, as determined by the Engineer. The Contractor shall keep the checks in good condition by replacing broken or damaged bales immediately after damage occurs. Normal debris cleanout shall be considered routine maintenance.

3.3.2 Temporary Diversion Fences and Silt Fences

3.3.2.1 Temporary silt fences shall be placed on the natural ground, at the bottom of fill slopes, in ditches, or at other areas where siltation is a problem. Silt fences are constructed of material designed for that application or some other approved material on the up-grade side of the fence, and anchored into the soil.

3.3.2.2 The Contractor shall be required to maintain silt fencing in a satisfactory condition for the duration of the project or until removal is approved by the Engineer. The silt accumulation at the fences shall be removed and properly disposed, as directed by the Engineer. The silt fencing becomes the property of the Contractor whenever the fence is removed.

3.3.2.3 The fence shall be fastened to the fence posts with metal clips 12 inches on center or an approved equal compatible with the fence material. The filter material shall be fastened to the fence at the top, center, and bottom with double stitching of heavy-duty (maximum 6 inches) cord.

3.4 MAINTENANCE

The temporary erosion control features installed by the Contractor shall be acceptably maintained by the Contractor until no longer needed or until permanent erosion control methods are installed. The erosion and sediment control features shall be inspected weekly and after each storm event. Required repairs shall be performed in a timely manner. Any related materials removed shall become the property of the Contractor.

END OF SECTION

SECTION 02510

WATER SERVICE LINE

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, equipment, materials, and incidentals to connect potable water line, all associated valves and valve boxes and any other water line related features to the groundwater treatment facility. The Contractor shall provide sufficient quantity of water for potable use, washing and decontamination of equipment, sanitation use, and fire protection use.

1.1.2 The Contractor shall coordinate work with the appropriate utility company, Public Works Department and town/borough authorities and perform work in accordance with local code.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

<u>AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)</u>

NSF/ANSI 61	Drinking Water System Component

<u>AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)</u>

ASTM B 88	Seamless Copper Water Tube

<u>AMERICAN SOCIETY OF SANITARY ENGINEERS (ASSE)</u>

ASSE 1001	Atmospheric Type Vacuum Breakers
ASSE 1011	Hose Connection Vacuum Breakers
ASSE 1012	Backflow Preventer with Intermediate Atmospheric Vent
ASSE 1013	Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
ASSE 1020	Pressure Vacuum Breaker Assembly

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) INTERNATIONAL

ASME B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ASME A112.1.2	Standard for Air Gaps in Plumbing Systems

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	AWWA Standard for Metal-Seated Gate Valves for Water Supply Service
AWWA C509	American National Standard for Resilient-Seated Gate Valves for Water Supply Service
AWWA C651	AWWA Standard for Disinfecting Water Mains
AWWA C700	Standard for Cold Water Meters-Displacement Type, Bronze Main Case
AWWA C701	Standard for Cold Water Meters - Turbine Type for Customer Service

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 704	Identification of the Fire Hazards of Materials for Emergency Response

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Valves; Shop Drawings; EA

The Contractor shall submit for Engineer approval, detailed drawings showing the locations, methods, and details of installation for valves, valve boxes, and related appurtenances. The submittal shall include a complete list of materials and equipment, complete with manufacturer's descriptive product data, technical literature, catalog cuts, performance charts and curves, and installation instructions, the names of local suppliers, and the date of delivery of materials on the job site.

1.3.2 Material List; Product Data; EA

The submittal shall consist of a list of materials to be furnished, the names of the suppliers, the date of delivery of material to job site and manufacturers' literature identifying that such materials comply with the requirements specified herein to the Engineer for approval prior to use on site. The Contractor shall also submit operation and maintenance data, lubrication instructions, and warranty information.

1.3.3 Satisfactory Installation; Product Data; EA

The Contractor shall submit a statement of satisfactory installation signed by the Contractor or the local utility authority, upon completion of the installation and testing, stating the installation is satisfactory and in accordance with the Contract Documents and the manufacturer's recommendations.

1.3.4 Certificates of Compliance; Certificates; FIO

The Contractor shall submit manufacturer certificates of compliance for all materials prior to use. Certificates shall confirm that materials meet the requirements of the specification and the local authorities.

1.3.5 Hydrostatic Testing and Disinfection; Test Reports; EA

The Contractor shall submit results from hydrostatic tests and submit bacteriological samples to the local utility authority laboratory to certify disinfection.

1.3.6 Installation Instructions; Manufacturer's Instruction; FIO

The Contractor shall submit manufacturer's recommendations for the installation and hydrostatic testing of each type of piping used.

PART 2 PRODUCTS

Local utility authority requirements for the replacement of water lines shall supersede the requirements listed below, and all specifications shall be confirmed with the appropriate authority at the time work is performed. The Contractor shall coordinate with the appropriate Public Works Department and town/borough authorities to determine the preferred manufacturer and model for all related products prior to procurement and installation. All materials shall be in accordance with ANSI/NSF-61.

2.1 PIPE AND FITTINGS

2.1.1 Copper Tubing and Fittings

Copper tubing shall conform to ASTM B 88, Type K, annealed, and shall meet the maximum working pressure and hydrostatic test pressure of the system. All copper tubing service lines shall be the same size as the existing service but no smaller than one inch. Fittings and specials shall be flared and conform to ASME B16.26. Joints shall be compression-pattern flared and shall be made with the special fittings.

2.1.2 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.3 VALVES AND VALVE BOXES

2.3.1 Gate Valves

2.3.1.1 Gate valves shall be resilient seat gate valves as determined by the local utility authority and the Engineer. All gate valves shall be iron body, inside screw, fully bronze mounted, in accordance with or exceed the standards of AWWA C509. Gate valves shall be designed for the maximum working pressure and hydrostatic test pressure of the system. Valves shall be designed to work equally well with pressure on either side of the gate. Valve shaft shall be of one piece extending full size through the valve disc. Stub shafts will not be acceptable.

2.3.1.2 Valve connections shall be as required for the piping in which they are installed. There shall be a resilient rubber seat ring mounted to the valve disc with stainless steel screws. The rubber ring shall seat against a machined surface of the valve body.

2.3.1.3 Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning in the direction as specified by the appropriate local utility authority specifications. The operating nut shall be a 2-inch square wrench nut. An arrow showing the direction of opening and the word "OPEN" shall be cast on the flange of the operating nut.

2.3.1.4 Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, or as otherwise required by the local utility authority.

2.3.2 Tapping Sleeves and Valves

2.3.2.1 Tapping sleeves and valves shall be suitable for the maximum working pressure and hydrostatic test pressure of the system and approved by the local utility authority and the Engineer.

2.3.2.2 Tapping sleeves shall be mechanical joint type. The Contractor shall have on hand spare gaskets to suit each class of pipe to be used on site.

2.3.2.3 Tapping valves shall be similar to gate valves except that they shall be provided with flanged inlet-mechanical joint outlet ends. Mechanical joint outlets shall be provided with ductile iron retainer glands, and approved by the local utility authority and the Engineer.

2.3.3 Valve Boxes

2.3.3.1 Valve boxes shall be approved by the local utility authority and the Engineer. Each buried valve shall be provided with a cast iron, two piece, and extension type with slide-type adjustment valve box. Valve boxes shall be 5-1/4 inches shaft with a round base and shall be provided with extra deep covers with the word "WATER" cast on and an arrow indicating direction of opening.

2.3.3.2 Contact surfaces of frames and covers shall be machined so that the covers rest securely in the frames with no rocking and with the cover in contact with the frames for the entire perimeter of the contact surface.

2.3.3.3 The length of valve boxes and size of base shall be as required to suit each particular installation but shall always have about eight inches of adjustment up and down available after setting to grade.

2.3.3.4 Extension stems shall be provided for all buried valves and shall extend to a minimum of 1 foot below grade.

2.3.3.5 Valve operators shall be of the traveling nut type designed to withstand a minimum input torque at fully open or fully closed position of 300 foot-pounds without damage to the valve or operator.

2.4 BACKFLOW PREVENTER

Backflow preventers shall be approved and listed by the Foundation for Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (non pressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR Manual or in accordance with the Village of Garden City requirements. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.5 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, as provided by the local utility. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

2.6 MISCELLANEOUS ITEMS

The Contractor shall be responsible for providing all materials and labor for the restoration of all affected service lines and assemblies. The Contractor shall coordinate specific product manufacturer requirements with the local utility authorities.

2.7 INSPECTION OF MATERIALS

The Contractor shall allow and coordinate for the inspection by the Engineer, local utility authority, or other so directed inspection agency, of all materials to be used in the construction, during any phase of the procurement, storage, or installation. The local utility authority and/or Engineer reserve the right to refuse the use of any materials which they deem to be unsatisfactory due to damage or non-compliance with their applicable requirements. The Contractor shall be responsible for coordinating with all parties to ensure that the materials used shall be satisfactory to the appropriate utility authorities.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

3.1.1 The Contractor shall coordinate installation of all water lines work with local utility authorities.
3.1.2 Water lines shall be installed in accordance with the requirements specified herein, unless otherwise approved by the Engineer.

3.1.3 The Contractor shall protect all water lines encountered during the trenching. Water lines damaged as a result of construction work shall be replaced and repaired.

3.1.4 Water lines shall never be installed in trenches which are not suitable for placement of such structures. Unsuitable conditions include, without limitation, the presence of excess stones, rocks, and other potentially damaging materials; frozen or saturated conditions; visible ponding; or uncompacted conditions.

3.1.5 The Contractor shall be responsible for installing all backflow prevention, metering, and valves in accordance with the local utility authority and health department requirements.

3.1.6 Any vaults that are required for meters, valves, etc. shall be constructed in accordance with the DIVISION 3 - CONCRETE specifications.

3.1.7 Electrical equipment and wiring required for meters shall be provided and performed in accordance with the DIVISION 16 - ELECTRICAL specifications.

3.2 HANDLING

Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place. Particular care shall be taken not to injure the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made at the Contractors expense in a satisfactory manner. No other pipe or material of any kind shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material. Storage facilities shall be classified and marked in accordance with NFPA 704.

3.3 INSTALLATION

3.3.1 Cutting of Pipe

Cutting of pipe shall be done in a neat manner. Cut pipe so that valves, fittings, or closure pieces can be inserted in a neat and workmanlike manner and without any damage to the pipe. The cutting process shall not deform the cross-sectional area of the pipe or negatively impact the structural integrity of the piping system. Unless otherwise recommended by the manufacturer and authorized by the Engineer, cutting shall be done with an approved type mechanical cutter. An abrasive cutting wheel shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron. All cut ends shall be cleaned, smoothed, and beveled to avoid damage to the gasket and allow for proper installation.

3.3.2 Adjacent Facilities

3.3.2.1 Sewer Lines

The water pipe shall not be laid closer horizontally than 10 feet from sewer except where the bottom of the water pipe will be at least 2 feet above the top of the sewer pipe. Where appropriate separation between the water and sewer main is not possible or where a water line crosses under a sewer line, the sewer pipe for a minimum distance of 10 feet on each side of the crossing shall be fully encased in concrete. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall not be less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.3.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.3.2.3 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, such as copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches shall be maintained between pipes.

3.3.2.4 Copper Tubing Lines

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.3.2.5 Driveways or Parking Lot

Where a water pipe is required to be installed under a driveway or parking lot, the pipe shall be encased in a sleeve of rigid conduit. A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sand bedding shall be provided for the water pipe through the sleeve.

3.3.2.6 Structures

Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required for driveways or parking lot. Care shall be exercised and proper precautions taken during installation of the water pipe and sleeve to assure that there will be no damage to the structures and any settlement or movement of foundations or footings.

3.3.3 Joint Deflection

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Engineer, but in no case it should exceed five degrees.

3.3.4 Placing and Laying

3.3.4.1 Prior to water line placement, trenches shall be compacted in accordance with SECTION 02300 - EARTHWORK. The Contractor shall trim the bottom of all trenches to receive pipe and shall provide finish grade by hand methods. The trench bottom shall be carefully graded to the proper elevation, and the maximum practical solid bearing areas shall be provided throughout its entire length, prior to laying the pipe in place. No blocking under the pipe will be permitted. Additional excavation shall be made under joints to allow for proper jointing. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate joints.

3.3.4.2 Pipe and accessories shall be carefully lowered into the trench by means of a derrick, ropes, belt slings, or other methods, as approved by the Engineer. Under no circumstances shall any of the water line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Lay no pipe in water or when it is the Engineer's opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding the pipe, its use is considered incidental to the project, and no separate payment will be made for its use. Pipe that has the grade or joint disturbed after laying shall be taken up and reinstalled. Water shall be kept out of the trench until joints are complete. If the joints of any pipe in the trench cannot be completed until a later time, caulk them with packing in order to make them as watertight as possible; this shall be done not only at the end of each working day but also before work is stopped for lunch periods, bad weather, or any other reason. If there is water in a trench, leave this seal in place until the trench has been pumped completely dry.

3.3.4.3 When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Pipe ends left for future connections shall be valved, plugged, or capped and anchored.

3.3.4.4 All materials to be used on site shall be inspected carefully for any defects or damage prior to installation. No damaged pipe or joints shall be used in the work.

3.3.4.5 Connections

3.3.4.5.1 Where connections are made between new work and existing valves, the connections shall be made by using specials and fittings to suit the actual conditions. Where made under pressure, these connections shall be installed using standard methods as approved by the Engineer.

3.3.4.5.2 Methods used for making connections to various types of pipe under pressure condition shall be approved by the Engineer and in conformance with the requirements of the local utility authority.

3.3.4.6 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.3.5 Jointing

3.3.5.1 Connections

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Engineer.

3.3.5.2 Copper Tubing

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut that is part of the fitting, so there is metal-to-metal contact.

3.3.5.3 Dielectric Fittings

Dielectric unions shall be encapsulated in a field-poured coal tar covering, with at least 1/8 inch thickness of coal tar over all fitting surfaces.

3.3.6 Buried Valve Installation

3.3.6.1 Buried valves and boxes shall be installed in conformance to AWWA C500 as applicable, except as specified herein. Valves shall be set truly plumb with the operating stem vertically aligned in the center. Valves shall be set on a firm foundation and supported by tamping selected excavated material under and at the sides of the valve.

3.3.6.2 Valve boxes shall be installed vertically, centered over the operating nut, and the elevation of the top shall be adjusted to conform with the finished surface of roadway or other surface at the completion of the contract. Boxes shall be adequately supported during backfilling to maintain vertical alignment. Valve boxes shall have slide type adjustment.

3.3.7 Shop Painting Valves and Appurtenances

3.3.7.1 Exposed valves and appurtenances shall be painted or coated by suitable material to prevent rust on components until the time of installation. The pipe connection openings shall be capped to prevent the entry of foreign matter prior to installation.

3.3.7.2 All gears, bearing surfaces and other surfaces not to be painted shall be given a heavy coat of grease or other suitable rust-resistant coating unless otherwise specified herein. This coating shall be maintained as required to prevent corrosion during any period of storage and installation, and shall be satisfactory to the Engineer throughout the time of final acceptance.

3.3.7.3 Ductile iron vent pipes shall have the types of paint scheduled below applied at the dry film thickness (DFT) in microns (mils) per coat noted, after all metal welds, blisters, etc., have been ground and sanded smooth; all pits and dents have been filled and all imperfections have been corrected to provide a smooth surface for painting; and all rust, loose scale, oil, grease and dirt have been removed by use of approved solvents, wire brushing or sanding.

3.3.7.4 One coat Chem-Prime (No. 77) - phenolic fortified alkyd on properly prepared unprimed metal or touch-up (2.0-3.0 mils DFT).

3.3.7.5 One coat Hi-build Epoxoline (Series 66) - polyamide cured epoxy.

3.3.7.6 One coat Endura-Shield-gloss (Series 71) - aliphatic polyurethane.

3.4 HYDROSTATIC TESTS

3.4.1 Pressure Test

After the pipe is laid, the joints completed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for one hour to a hydrostatic pressure test. For the pressure test, a minimum hydrostatic testing pressure of 50 psi greater than the maximum working pressure of the system for pipes less than 2 inches in diameter or 200 psi for pipes larger than 2 inches in diameter, or as otherwise required by the local utility authority, shall be used. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Engineer when soil conditions in the trench are wet or unstable; compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions; or maintaining the trench in an open condition would delay completion of the contract.

3.4.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least two hours, and during the test the water line shall be subjected to not less than the maximum working pressure, or as otherwise required by the appropriate utility authority. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted if leakage exceeds the allowable leakage, which is determined by the following formula:

$L = 0.0001351NDP^{.5}$
L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired, and the test shall be performed again until the leakage is within the specified allowance, without additional cost to the Government.

3.4.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a five day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.4.4 Pressure test and leakage test may be conducted concurrently.

3.4.5 Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be re-applied.

3.4.6 Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government

3.4.7 Valve Testing

Testing of valves shall be done visually. Operation shall be satisfactory to the Engineer in all respects, prior to acceptance.

3.5 DISINFECTION

3.5.1 Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as specified by AWWA C651. Disinfection shall be coordinated with the Engineer and with the appropriate utility authority.

3.5.2 Testing shall be performed following chlorination to certify the pipe is ready for placement into permanent service. After chlorination has been completed, and after the entire length of line is ready for operation, all treated water in the pipe shall be flushed thoroughly from the newly laid pipe, at its extremities, using a clean water source. Flushing shall continue until the replacement water throughout the entire length of pipe being disinfected will upon test, for both chemical and bacteriological measures, be proved equal to the quality introduced at the permanent source of supply. Samples for laboratory analysis shall be taken after water has stood in the main for <u>at least 24 hours</u> following the flushing stage. Should the samples indicate that the initial treatment was ineffective, the chlorination, flushing, and sampling procedure shall be repeated as directed by the Engineer and/or local utility authority representative, until the confirmed tests show the water are suitable for public service.

3.5.3 The aforementioned samples shall be collected by personnel from the Contractor's approved commercial laboratory, and shall consist of at least three or more water samples taken from different points along the line to be tested, as approved by the Engineer. Samples shall be collected in proper sterilized containers and shall undergo a chemical and bacterial examination in accordance with State approved methods. The commercial laboratory must be certified as a State certified potable water testing laboratory for the performance of all bacteriological testing. The disinfection shall be repeated until tests indicate the absence of pollution for at least two full days. Disinfection shall be certified by an independent laboratory.

3.5.4 The unit will not be accepted until satisfactory bacteriological results have been obtained. No newly installed water main shall be placed into public service until approval is given by the Engineer.

3.6 BACKFILL AND COMPACTION

Water piping systems shall be backfilled as specified in SECTION 02300 - EARTHWORK, and shown on the Contract Drawings.

3.7 CLEANUP

Upon completion of the installation of water lines and appurtenances, all debris and surplus materials resulting from the work shall be removed.

END OF SECTION

SECTION 02525

WELL INSTALLATION AND TESTING

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall provide all necessary labor, associated materials and equipment, and other facilities and incidentals to locate, drill, install, and develop three extraction wells and six monitoring wells, conduct step tests, and complete (e.g. pump installation, well vault construction, etc.) the extraction wells.

1.1.2 The Contractor shall install three 8-inch diameter extraction wells (EW-01S, EW-01I, and EW-01D) with depths, respectively, of 275 feet, 345 feet, and 415 feet below ground surface (feet bgs). Each extraction well will have a 60-foot long screen. The target screen elevations (feet amsl) will range from approximately −125 feet to −185 feet at well EW-01S; from −195 feet to −255 feet at well EW-01I; and −265 feet to −325 feet at well EW-01D. Extraction wells EW-01S and EW-01I shall each be capable of producing 60 gallons per minute (gpm). Extraction well EW-01D shall be capable of producing 80 to 130 gpm. Each extraction well shall include a 5-foot sump below the bottom of the screen. The exact screened interval shall be determined in the field, based upon the stratigraphy encountered at the well location, and then approved by the Engineer prior to installation. Locations for the extraction wells are shown on the Contract Drawing.

1.1.3 The Contractor shall install six 4-inch diameter monitoring wells (MW-1S, MW-1I, MW-2S, MW-2I, MW-3S, and MW-3I) to monitor the capture zone of the extraction wells. The estimated depth of each shallow (S) well is 246 feet and the estimated depth of each intermediate (I) well is 316 feet. Monitoring wells will be installed in three clusters of two wells each. Each well shall be constructed with a 10-feet screen. The target interval depths are shown on the Contract Drawing. The exact screened intervals shall be determined in the field and approved by the Engineer prior to installation. The monitoring wells shall be located as shown on the Contract Drawings. The Contractor may modify the proposed monitoring locations based on site access conditions. Revised locations will be submitted for approval by the Engineer prior to installation.

1.1.4 Construction details for the extraction wells and monitoring wells including locations, desired screened intervals, materials of construction, and approximate depths are shown on the Contract Drawings.

1.1.5 Property access for extraction well and monitoring well installation have been obtained by the U.S. Environmental Protection Agency (EPA).

1.1.6 Site geology and hydrogeology are described in SECTION 01010 - SUMMARY OF WORK.

1.1.7 One test boring shall be installed in the proximity of the extraction well locations prior to construction of the extraction wells. A test boring of sufficient depth shall advanced to obtain samples of the formation material to be analyzed for grain-size distribution to support the design of the filter pack and well screen material for each well. The drilling method shall be determined by the Contractor. Borehole logging, sampling and grain-size analysis shall be performed as specified in Paragraph 3.2.3 – Test Boring. The test boring shall be abandoned immediately after sample collection in accordance with Paragraph 3.10 – TEST BORING AND WELL ABANDONMENT.

1.1.8 Step-drawdown testing shall be performed on extraction wells EW-01S, EW-01I, and EW-01D to determine each well's maximum yield and specific capacity. Groundwater samples will be collected from each extraction well and analyzed for Volatile Organic Compounds (VOCs) iron and manganese. The samples will be collected after the sand content test is completed and after the step testing is completed at each well. A sustained yield test will be performed after step testing is completed. During this test all three wells will be pumped at the same time at constant flow rates and water level data will be collected.

1.1.9 Extraction wells EW-01S and EW-01I shall each be capable of continuously pumping an average of 60 gpm and extraction well EW-01D shall be capable of continuously pumping in the range of 80 to 130 gpm or as approved by the Engineer based on the extraction well performance testing.

1.1.10 Before starting site preparation work for the construction of extraction wells and monitoring wells the Contractor shall obtain utility clearance for all drilling locations, including a site specific geophysical survey, as described in Paragraph 3.1 - PROTECTION OF EXISTING CONDITIONS.

1.1.11 Before starting construction the Contractor shall survey the ground surface elevation at each of the four drilling locations (extraction well cluster and each of the three monitoring well clusters). This information will be reported to the Engineer and will be used to finalize extraction well and monitoring well depths.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. Publications are referred in the text by basic designation only. Where reference is made to one of the below standards, the revision in effect at the time of the contract award shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 999	Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
ASTM D 422	Standard Test method for particle-size analysis of soils
ASTM C 150	Standard Specification for Portland Cement
ASTM D 1586	Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils
ASTM D 2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D 5088	Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites
ASTM D 6698-07	Standard Test Method for On-Line Measurement of Turbidity Below 5 NTU in Water

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C654-03	Standard for Disinfection of Wells
AWWA A100	Water Wells

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 570/9-75-001	Manual of Water Well Construction Practices
EPA 600/4-79/020	Methods for Chemical Analysis of Water and Wastes

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC)

Ch. 5 Part 555	Plugging and Abandonment
Ch. 5 Part 602	Applications for Long Island Wells

MANUFACTURER'S GUIDELINES

Groundwater and Wells, Fletcher Driscoll, 1986, Johnson Division, UOP, St. Paul, MN

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Lithologic (Boring) Logs; Product Data; EA

Borehole logs as described in Paragraph 1.8.1 – Lithologic (Boring) Logs

1.3.2 Well Installation Reports; Product Data; FIO

Well installation reports as described in Paragraph 1.8.2 - Well Construction Diagrams. In addition, the Contractor shall also submit a Long Island Well Completion Report for each well installed in accordance with NYSDEC

1.3.3 Well Development Records; Certificates; EA

Well development records as described in Paragraph 1.8.3 – Well Development Records.

1.3.4 Well and Test Boring Abandonment Records; Certificates; EA

Well and test boring abandonment records as described in Paragraph 1.8.4 - Well and Test Boring Abandonment Records.

1.3.5 Field Notebooks; Certificates; EA

Field notebooks as described in Paragraph 1.8.6 – Field Notebooks.

1.3.6 Catalog Data; Product Data; FIO

Submit catalog data for well screens (to include the screen slot size), permanent stainless steel casing, riser pipe, filter pack material, sand seal material, bentonite, cement, centralizers, surface protective covers, locking caps, storage containers, and chemical specifications on drill lubricants. Catalog data shall include any information, written or otherwise, supplied by the manufacturers or suppliers of the above listed items.

1.3.7 Grain Size Distribution Test Results; Test Reports; EA

Report the results of grain size analyses and recommendations for filter pack and well screen design.

1.3.8 Filter Pack Grading Data; Test Reports; EA

Report filter pack material test results/sieve analyses.

1.3.9 Well Testing and Sampling; Test Reports; EA

1.3.9.1 Sand content results

Report the results of the sand content test as discussed in Paragraph 3.3.8.5.

1.3.9.2 Plumbness and Alignment Testing

Report the results of the plumbness and alignment testing as discussed in Paragraph 3.4.1.

1.3.9.3 Step Drawdown Testing

Field reports that present drawdown versus time data for the step tests shall be made within one week following the conclusion of each test and provided to the Engineer. The data shall be provided graphically. A final report that presents the results of the step drawdown tests described in Paragraph 3.4.2 – Step Drawdown Testing shall be submitted within 10 working days after the final test is completed. The time-drawdown data presented graphically in the report shall also be provided electronically (in MS Excel format) with the report. The report shall include a summary of the methods used, problems encountered and solutions, the graphical presentation of the drawdown data, tables listing flow rates and durations, and tables listing water level observations, and raw data files from all transducers. All data and results will be provided in electronic format.

1.3.9.4 Sustained Yield Test Results

Field reports that present drawdown versus time data for the sustained yield test shall be made within one week following the conclusion of the test and provided to the Engineer. The data shall be provided graphically. A final report that presents the results of the sustained yield test described in Paragraph 3.4.3 – Sustained Yield Test shall be submitted within 30 calendar days after the test is completed. The time-drawdown data presented graphically in the report shall also be provided electronically (in MS Excel format) with the report. The report shall include a summary of the methods used, problems encountered and solutions, the graphical presentation of the drawdown and recovery data, tables listing flow rates and durations, and tables listing water level observations, and raw data files from all transducers. All data and results will be provided in electronic format.

1.3.9.5 Water Quality Sample Reports

A final report that presents the results of the water quality sampling described in Paragraph 3.5 – WATER QUALITY SAMPLING shall be submitted within 15 calendar days after the last sample is completed. The report shall include a summary of the methods used, problems encountered and solutions, chain-of-custody forms, and results tables. All data and results will be provided in electronic format.

1.3.10 Qualifications; Certificates; FIO

Qualification documentation in accordance with Paragraph 1.4 – QUALIFICATIONS.

1.3.11 Permits and Licenses; Certificates; FIO

Provide copies of all permits, licenses, or other requirements necessary for execution of the work.

1.3.12 Utility Clearance Records; Certificates; FIO

Results of communications with property owners, results of the geophysical survey, and utility clearance records shall be prepared in accordance with Paragraph 3.1 - PROTECTION OF EXISTING CONDITIONS and submitted to the Engineer prior to the start of drilling. Utility clearance shall be updated as necessary so that no drilling is performed after the utility clearance period has expired.

1.3.13 Drilling Methods; Pre-Construction Submittals; EA

The drilling method or methods for completion of the test boring, extraction wells, and monitoring wells shall be described by the Contractor. The description shall include the method used to advance the borehole, the type of drilling fluid, borehole diameters, the size of the drill bits, and the estimated amount of investigation derived waste expected.

1.3.14 Water Sample Results; EA

The result of the water sample collected as described under Paragraph 2.8 - WATER shall be reported to the Engineer within 15 calendar days of sample collection in accordance with

SECTION 01450 – CHEMICAL DATA QUALITY CONTROL. This water will be used for drilling and equipment decontamination purposes.

1.4 QUALIFICATIONS

A geologist or engineer with the appropriate baccalaureate degree from an accredited university with a minimum of 5 years experience in hazardous waste projects, soil logging, groundwater extraction and monitoring well installation and testing, monitoring well installation, and well abandonment shall be onsite and perform all borehole logging, drilling, well installation, well development activities, well testing activities, water sampling, and well abandonment activities.

The geologist, engineer, or technician responsible for operating the Westbay equipment used to collect water level data, see PARAGRAPH 3.4 – WELL TESTING, shall be trained by Westbay to perform the necessary work and operate the necessary equipment and shall provide documentation of this training.

The driller responsible for installing the extraction and monitoring wells must be experienced in the use of the appropriate drilling equipment and have successfully completed similar extraction wells and monitoring wells to similar depths.

1.5 REGULATORY REQUIREMENTS

1.5.1 Permits and Licenses

Local, State, or Federal permits or licenses required to perform the work included in this contract shall be obtained by the contractor prior to commencing drilling and well installation operations.

1.5.2 Statutes and Regulations

Work required by this specification shall be conducted in strict compliance with applicable local, State, and Federal regulations, statutes, and codes. Compliance shall be the responsibility of the Contractor.

1.5.3 Groundwater and Drill Cuttings

Groundwater removed from the subsurface during drilling, development and testing, drilling fluids and drill cuttings shall be treated and/or disposed of in accordance with Paragraph 3.3.10 – Handling of Development Water and Drill Cuttings.

1.6 DELIVERY, STORAGE, AND HANDLING

Well materials shall be stored and maintained in a clean, uncontaminated condition throughout the course of the project. Material shall be protected from contamination or damage prior to placement by either storing it in plastic lined bags, or in a location protected from the weather and contamination on plastic sheeting. Material shall be transported to the well site in a manner that prevents contamination by other soils, oils, grease, and other chemicals.

1.7 SITE CONDITIONS, PROTECTION OF EXISTING FACILITIES, AND ENVIRONMENTAL PROTECTION

1.7.1 Physical access to the well sites, including any utility clearance, shall be the responsibility of the Contractor. The Contractor shall visit the proposed well locations to observe any condition that may hamper transporting equipment or personnel to the site. If clearing or relocation is necessary, the Contractor and the Engineer shall agree on a suitable clearing or relocation plan and the location of any required access road.

1.7.2 The Contractor shall protect all surface and subsurface structures and surrounding areas from damage that may result from the methods employed in performing the work. The Contractor shall be responsible for any damages resulting from his operations. Damage to property shall be repaired or replaced at no additional cost to the Government to the existing condition. The Engineer shall have the right to approve these restoration measures.

1.7.3 The Contractor shall take all precautions as may be required to prevent contaminated water or water having undesirable physical or chemical characteristics from entering the water supply through the well bore or by seepage from the ground surface. The Contractor also shall take all precautions necessary to prevent contamination of the ground surface or surface waters resulting from drilling of the test-hole or well. The Contractor shall secure the borehole at the end of each day by covering it so as to prevent vandalism or contamination of the borehole.

1.8 DOCUMENTATION AND QUALITY CONTROL REPORTS

The Contractor shall establish and maintain documentation and quality control reports for well construction and development to record the desired information and to assure compliance with contract requirements. In addition, all forms required by the State of New York for installation of wells shall be completed by the Contractor and returned to the appropriate agency, as well as a copy provided to the Engineer.

1.8.1 Lithologic (Boring) Logs

A borehole log shall be completed for each well drilled. A qualified geologist or engineer present shall prepare borehole logs during all well drilling and installation activities. Copies of completed logs shall be kept current in the field at each well site and shall be available at all times for inspection by the Engineer. Information provided on the logs shall include, but not be limited to, the following:

1.8.1.1 Name of the project and site.

1.8.1.2 Boring/well identification number (NYSDEC permit number, if applicable).

1.8.1.3 Location of boring (coordinates, if available).

1.8.1.4 Make and manufacturer's model designation of drill rig and name of drilling firm.

1.8.1.5 Date boring was drilled.

1.8.1.6 Reference point for all depth measurements.

1.8.1.7 Name of driller and name and signature of geologist or engineer preparing log.

1.8.1.8 Nominal borehole diameter and depth at which borehole diameter changes.

1.8.1.9 Total depth of boring.

1.8.1.10 Method of drilling, including information such as rod size, bit size and type, pump type, etc. shall be recorded. Also include a description of any temporary casing used, drill fluids, and fluid additives used, if any, including brand name and amount used. If used, mud viscosities and weight shall be recorded.

1.8.1.11 Depth of each change of stratum. If location of strata change is approximate, it should be so stated.

1.8.1.12 Description of the material of which each stratum is composed, in accordance with ASTM D 2488. Soil parameters for logging shall include, but not be limited to classification, depositional environment and formation, if known, Unified Soil Classification Symbol, secondary components and estimated percentages, color, plasticity, consistency (cohesive soil), density (non-cohesive soil), moisture content, and grain angularity. Classification shall be prepared in the field at the time of sampling. The results of visual observation of the material encountered, and any unusual odor detected shall also be duly noted and recorded.

1.8.1.13 Depth and estimated percent of drill fluid loss or lost circulation. Measures taken to regain drill water circulation. Significant color changes in the drilling fluid return.

1.8.1.14 When applicable, depth to water and date measured before, during, and after each drilling shift, and prior to well installation. The Contractor shall provide and maintain at each well under construction a portable water-measuring device of sufficient length to measure the water level to 300-foot depth. The device shall be available at all times and measuring tape shall be graduated in 0.01 foot. Water level measurements shall be taken to the nearest 0.01-foot.

1.8.2 Well Construction Diagrams

The well shall not be accepted before the geologic logs and installation diagrams are received and reviewed. The diagram shall illustrate the as-built condition of the well and include, but not be limited to, the following items:

1.8.2.1 Name of the project and site.

1.8.2.2 Well identification number (NYSDEC permit number, if applicable).

1.8.2.3 Name of driller and name and signature of the geologist preparing diagram.

1.8.2.4 Date of well installation.

1.8.2.5 Description of material from which the well is constructed, including well casing/riser pipe and screen material; centralizer composition; diameter and type of casing and screen; screen slot size; gradation of filter pack; lithologic description; brand name (if any), source, processing method, and method of placement of the filter pack; and type of protective cover.

1.8.2.6 Total depth of well.

1.8.2.7 Nominal drilled hole diameter.

1.8.2.8 Depth to top and bottom of screen, and filter pack.

1.8.2.9 Depth to top and bottom of any seals installed in the well boring (grout or bentonite).

1.8.2.10 Type of cement and/or bentonite used, mix ratios of grout, method of placement and quantities used.

1.8.2.11 Elevations, depths, and heights of key features of the well, such as top of casing or riser pipe, top and bottom of protective casing, ground surface, bottom of well screen, top and bottom of filter pack, and top and bottom of seal. Surveying work will be as specified in Paragraph 3.9 - SURVEYS of this specification and SECTION 01550 – SURVEYING.

1.8.2.12 Other pertinent construction details, such as slot size and percent open area of screen, type of screen, and manufacturer of screen.

1.8.2.13 Well location by coordinates. A plan sheet shall also be included showing the coordinate system used and the location of each well. A plan sheet is not required for each well installation diagram; multiple wells may be shown on the same sheet.

1.8.2.14 Static water level upon completion of the well.

1.8.2.15 Special problems and their resolutions; e.g., grout in wells, lost casing, or screens, bridging, etc.

1.8.2.16 Description of surface completion.

1.8.3 Well Development Records

A well development record shall be prepared for all extraction wells and monitoring wells. Information provided on the well development record shall include, but not be limited to, the following:

1.8.3.1 Date, time, and elevation of water level in the well, before development.

1.8.3.2 Depth to bottom of well, name of project and site, well identification number, and date of development.

1.8.3.3 Method used for development, to include size, type and make of equipment, bailer, and/or pump used during development.

1.8.3.4 Time spent developing the well by each method, to include typical pumping rate, if pump is used in development.

1.8.3.5 Volume and physical character of water removed, to include changes during development in clarity, color, particulates, and odor.

1.8.3.6 Volume of water added to the well, if any.

1.8.3.7 Volume and physical character of sediment removed, to include changes during development in color, and odor.

1.8.3.8 Source of any water added to the well.

1.8.3.9 Turbidity of water before, during, and after development. Turbidity observations shall be reported in Nephelometric Turbidity Units (NTU).

1.8.3.10 Total depth of well and the static water level from top of the casing immediately after pumping/development.

1.8.3.11 Readings of pH, specific conductance, and temperature shall be taken before, during, and after development. Well development shall be continued until pH, specific conductance, and temperature have stabilized (as described in Paragraphs 3.3.8 – Extraction Well Development and 3.3.9 – Monitoring Well Development) and the turbidity of the water is 50 NTU or less.

1.8.3.12 Name and qualifications of individual developing well.

1.8.3.13 Name and/or description of the disposal facility/area, for the waters removed during development.

1.8.3.14 Initial and final specific capacity of the well as pumping rate in gallons per minute divided by drawdown in feet.

1.8.3.15 Pumping rates with the associated drawdown measurements.

1.8.4 Well and Test Boring Abandonment Records

Abandonment records shall include, as a minimum, the following:

1.8.4.1 Project name

1.8.4.2 Well and boring number

1.8.4.3 Well and boring location, depth and diameter

1.8.4.4 Date of abandonment

1.8.4.5 Method of abandonment

1.8.4.6 All materials used in the abandonment procedure and the interval in which test materials were placed

1.8.4.7 Casing, and or other items left in hole by depth, description, and composition

1.8.4.8 Description and total quantity of grout used initially

1.8.4.9 Description and daily quantities of grout used to compensate for settlement

1.8.4.10 Water or mud level (specify) prior to grouting and date measured

1.8.4.11 The reason for abandonment of the hole

1.8.5 Performance Testing Records

Performance testing records shall be in accordance with Paragraph 3.4 – WELL TESTING.

1.8.6 Field Notebooks

The qualified representative personnel shall keep a dedicated field notebook for well installation. The notebook should have pre-numbered pages, be permanently bound, and have a waterproof cover. Information shall include, but not be limited to, the following:

1.8.6.1 Date and personnel present

1.8.6.2 Visitors to the site

1.8.6.3 Activities performed

1.8.6.4 Quantities of materials used

1.8.6.5 Any chemical sampling information

1.8.6.6 Weather conditions

1.8.6.7 Any problems encountered and their resolution

1.8.6.8 Any change in procedure, process, and the material use

1.8.6.9 Results of the sand content test and plumbness and alignment testing.

PART 2 PRODUCTS

2.1 WELL CASING

2.1.1 Extraction Wells

The extraction well casing and sump shall be constructed of 8-inch diameter, stainless steel. For EW-01S, EW-01I, and EW-01D, the casing shall be new, schedule 5S, type 304, stainless steel pipe. Joints shall be flush-threaded and equipped with an O-ring seal.

2.1.2 Monitoring Wells

The monitoring well casing and sump shall be constructed of 4-inch diameter, stainless steel. The casing shall be new, schedule 5S, type 304, stainless steel pipe. Joints shall be flush-threaded and equipped with an O-ring seal.

2.2 WELL SCREENS

2.2.1 Extraction Wells

The extraction well screen shall consist of new, factory fabricated, continuous slot well screen constructed of Type 304 stainless steel rated for the pressures expected based on the installation depths. Trapezoidal or "v-shaped" wire shall be helically wound around an array of equally spaced longitudinal rods and welded at each intersection. Screen and fittings shall be made of the same material as the screen body and shall be securely welded to each screen section. The Contractor, through the screen manufacturer, shall determine the size of the screen slots, based on filter pack gradation and analysis of samples collected from the proposed depth of the screen interval. The Contractor shall also consider the effects of a preventative maintenance program (type of acids used, contact time, frequency of treatments, etc.), site water chemistry, and temperature and pH in determining screen slot size and filter pack gradations. The bottom of the well shall be tightly sealed by means of a five-foot stainless steel casing sump with a flush-threaded or welded cap, equipped with an O-ring seal, compatible with the well screen.

2.2.2 Monitoring Wells

The monitoring well screen shall consist of new, factory fabricated, continuous slot well screen constructed of Type 304 stainless steel. Trapezoidal or "v-shaped" wire shall be helically wound around an array of equally spaced longitudinal rods and welded at each intersection. Screen and fittings shall be made of the same material as the screen body and shall be securely welded to each screen section. Screen couplings shall be flush-threaded, equipped with an O-ring seal, and compatible with the well casing.

2.3 FILTER PACK

The filter pack shall consist of commercially manufactured clean, washed, rounded to sub-rounded siliceous material free from calcareous grains or approved equivalent. The filter pack shall be appropriate size for the formation encountered.

2.3.1 Extraction Wells

The gradation of the filter pack for the extraction wells shall be determined by the Contractor according to the procedures described in Chapter 12 and Chapter 13 of Driscoll (1986), using the grain size analysis data obtained from formation samples or an alternative method upon approval from the Engineer. The uniformity coefficient of the filter pack material shall not exceed 2.0. The size of the 70 percent retained fraction of the filter pack shall be 4 to 10 times the size of the 70 percent retained fraction from the formation in which the screen is placed. A gradation analysis of the formation samples, filter pack material, and determination of screen slot size shall be submitted to the Engineer for approval prior to installation. The filter pack will be emplaced using a tremie pipe.

2.3.2 Monitoring Wells

The gradation of the filter pack for the monitoring wells shall be #1 Well Gravel. The filter pack will be emplaced using a tremie pipe. The #1 Well Gravel shall have the following grain size distribution or approved equivalent:

Mesh ASTM-11	Percent Retained for #00 Sand
10	0.2
12	4.3
14	29.7
16	32.1
18	25.7
20	5.2
25	1.5
30	0.5
35	0.3
Pan	0.5

2.4 BENTONITE/SAND SLURRY

A bentonite/sand slurry shall be used as an annular seal above the filter pack in both monitoring and extraction wells. The slurry shall consist of a mixture of 30% solids bentonite slurry and #0 Well Gravel. The bentonite/sand slurry shall be emplaced using a tremie pipe. The #00 sand shall have the following grain size distribution or approved equivalent:

Mesh ASTM-11	Percent Retained for #00 Sand
25	0.1
30	1.9
35	31.5
40	36
50	26.7
70	3
Pan	0.8

2.5 CEMENT/BENTONITE GROUT

Cement/bentonite grout shall consist of a mixture of Portland cement conforming to ASTM C 150 Type I or II, bentonite powder and potable water. The proportion of the mixture shall be as follows: One (1) 94 pound bag of cement, 5 pounds of bentonite, 8.3 gallons potable water. The acceptable target density range shall be 13.4 to 14.5 pounds/gallon.

2.6 EXTRACTION WELL PUMPS

Extraction well pumps shall be in accordance with SECTION 11319 – SUBMERSIBLE WELL PUMP.

2.7 LUBRICANTS

Tool joint lubricants used during drilling operations shall contain no petroleum products.

2.8 WATER

Any water used for drilling, sampling, or installation shall be potable water obtained from the local water company water distribution system. The Contractor shall be responsible for obtaining the water, transporting it to, and storing it where needed. Thirty calendar days before the start of drilling a water sample shall be obtained from the container used in transporting the water before the water is used for decontamination, drilling and well installation purposes. This sample shall be analyzed USEPA Target Analyte List (TAL) metals and Full Target Compound List (TCL).

2.9 SPLIT-SPOON SAMPLER

The split spoon sampler shall conform to ASTM D1586. The drive shoe shall be of hardened steel and shall be replaced or repaired if it becomes dented or distorted. The split spoon shall be 27-inch in length of which 18-inch will be split barrel construction.

2.10 LEVEL TRANSDUCERS

Level transducers will be as specified in SECTION 13405 - PROCESS INSTRUMENTATION AND CONTROLS – PRODUCTS.

PART 3 EXECUTION

3.1 PROTECTION OF EXISTING CONDITIONS

The Contractor shall maintain existing survey monuments and monitoring wells and protect them from damage from equipment and vehicular traffic. The Contractor shall repair any items damaged by the Contractor.

To avoid disturbing underground utilities and structures the Contractor shall, prior to the start of drilling, consult with the property owner, perform a geophysical survey, and obtain utility clearances using the "Dig Safely New York" system. The geophysical survey shall be capable of detecting buried utilities consisting of conductive and non-conductive materials. A geophysical survey is necessary because part of the work is located on private property where the "Dig Safely New York" system may not apply. The location work shall focus on a 15-foot radius around each drilling location. The results of property owner contacts; a brief report detailing methods and results and including a map showing any targets identified by the geophysical survey; and "Dig Safely" utility clearance records shall be submitted to the Engineer prior to drilling. Utility clearance (owner contact, geophysical survey, "Dig Safely" contact) shall be updated as necessary so that no drilling is performed after the utility clearance period has expired.

3.2 PREPARATION

3.2.1 Surveying

The Contractor shall survey the land surface elevation and location of each well cluster (extraction well cluster and three monitoring well clusters). The elevation shall be determined to the nearest 0.1 feet. The horizontal location shall be determined to the nearest foot. The coordinate system shall be the New York State Plane Coordinate System, Long Island Zone, North American Datum 1983 (NAD83) datum. The elevation datum shall be North American Vertical Datum (NAVD88). Coordinates and elevations shall be reported in feet. The results of the survey shall be communicated to the Contractor office before the start of drilling and shall be used to finalize the target elevation of the extraction and monitoring wells.

3.2.2 Decontamination

3.2.2.1 A temporary decontamination pad shall be constructed at the site where the drill rig, drill rods, drill bits, temporary casing, permanent casing (if required), well developing equipment, tremie pipes, grout pumping lines, and other associated equipment shall be cleaned with high-pressure hot water/steam prior to drilling at each well location. The design of the decontamination pad shall be submitted under SECTION 01500 – TEMPORARY CONSTRUCTION FACILITIES AND UTILITIES.

The equipment shall also be cleaned after the last borehole/well is drilled. Decontamination shall be conducted in accordance with ASTM D 5088 and SECTION 01351 – SAFETY, HEALTH, AND EMERGENCY REPONSES. Decontamination shall be performed at a central decontamination station. Stainless steel screen and well casing shall be factory decontaminated and packaged. Screen and casing shall be installed immediately after being removed from their packaging. The decontamination wash water shall be disposed of in accordance with Paragraph 3.3.10 – Handling of Development Water and Drill Cuttings. The water used for cleaning shall be in accordance with Paragraph 2.8 – WATER.

3.2.2.2 Split-spoon samplers shall be decontaminated after each use. The Contractor shall decontaminate the samplers with a non-phosphate detergent wash and a potable water rinse at the drilling location. The decontamination wash water shall be disposed of in accordance with Paragraph 3.3.10 – Handling of Development Water and Drill Cuttings.

3.2.3 Test Boring

The purpose of the test boring is to collect samples for lithologic characterization and for grain-size analysis at the location of the extraction wells EW-01S, EW-01I, and EW-01D. The results of the grain size analysis shall be used to design the filter pack gradations and to determine the screen slot size. The test boring drilling method shall be determined by the Contractor. Sampling intervals for the test borings shall be one sample every 5 feet from ground surface to 5 feet above the top of the shallowest proposed screen interval. Samples shall be collected in accordance with ASTM D 1586, or a continuous sampling method if approved by the Engineer. Sampling shall be continuous from 5 feet above the top of the shallowest proposed screened interval (EW-01S) to the bottom of the deepest proposed screen interval (EW-01D). Borehole logs shall be completed as specified in Paragraph 1.8.1 – Lithologic (Boring) Logs. Samples collected from the proposed screen intervals shall be submitted for grain size analysis in accordance with ASTM C 136 and ASTM D 2487 at a rate of one sample for every 10 feet of screen to be installed. The samples submitted for grain size analysis shall be biased to the finer grained material observed in the lithologic samples to ensure that the screen and sand pack are sized to keep this material out of the well. The test boring shall be abandoned to the surface using the specified cement-bentonite grout mixture installed by a tremie pipe. The hole shall be abandoned immediately after reaching the specified depth. The Contractor shall be responsible for review of the available literature concerning drilling conditions (i.e., previous drilling methods, subsurface drilling conditions, etc.). The test boring logs and grain size analysis reported shall be submitted to the Engineer for review.

3.3 WELL INSTALLATION

The Contractor shall install the extraction and monitoring wells in accordance with the Contract Drawings. The Contract Drawings show the approximate locations of the wells. The final location of the wells shall be staked or marked in the field by the Engineer or their representative, in consultation with the Contractor, based on property access, equipment access, and field conditions.

3.3.1 Drilling Methods

3.3.1.1 The drilling methods appropriate for the completion of the test boring, extraction wells, and monitoring wells shall be determined by the Contractor. During previous monitoring well installation at the site to depths similar to those in this specification, the Engineer had the most success installing well using the reverse circulation drilling method. The drilling method and equipment proposed shall be capable of completing the boreholes and wells to the required depths as described in these specifications. The drilling methods shall be a critical factor in evaluating the bid proposal. The Contractor shall show past experience with the proposed method or methods in conditions similar to those expected at the Site. The method shall be approved by the Engineer.

3.3.1.2 The drill rig(s) shall be free from leaks of fuel, hydraulic fluid, and oil that may contaminate the borehole, ground surface or drill tools. During construction of the wells, precautions shall be used to prevent tampering with the well or borehole or entrance of foreign material. Runoff shall be prevented from entering the well or borehole during construction. If there is an interruption in work, such as overnight shutdown or inclement weather, the well or borehole opening shall be closed with a watertight uncontaminated cover. The cover shall be secured in place or weighted down so that it cannot be removed except with the aid of the drilling equipment or through the use of drill tools.

3.3.1.3 Drilling equipment and tools shall be degreased, steam cleaned and decontaminated in accordance with Paragraph 3.2.2 – Decontamination prior to being mobilized onto each well site.

3.3.1.4 As appropriate based on drilling and subsurface conditions, use of drilling mud shall be minimized. Polymer based drilling additives may be used but must be approved by the Engineer in advance. All drilling fluids shall be approved by the Engineer. Before the drilling program starts, the Contractor shall submit a list of drilling fluid additives that plan to use or may need to use to complete the drilling program. The Engineer will review this list and pre-approve additives for use in the field to eliminate any delays during drilling.

3.3.2 Well Installation

3.3.2.1 Extraction Well Installation

Extraction well installation shall conform to NYSDEC requirements and the Contract Drawings. The following steps are required for extraction well installation:

1) Drill a nominal diameter borehole eight inches larger than casing diameter to depth (4-inch annular space)
2) As appropriate based on drilling and subsurface conditions, thin drilling mud, if used, by circulating fresh water.
3) Install stainless steel casing and screen interval in the borehole (see Paragraph 3.3.3)
4) Complete well installation (see Paragraphs 3.3.4 through 3.3.8)
5) Conduct well development (see Paragraph 3.3.9)
6) Conduct well performance testing (see Paragraph 3.4)
7) If well performance testing is acceptable to the Engineer, complete well construction (Paragraphs 3.6 through 3.9)
8) If performance testing is not acceptable to the Engineer, abandon the well and proceed to a new location specified by the Engineer (see paragraph 3.11)

3.3.2.2 Monitoring Well Installation

Monitoring well installation shall conform to NYSDEC requirements and the Contract Drawings. The following steps are required for monitoring well installation:

1) Drill a nominal diameter borehole four inches larger than casing diameter to depth (2-inch annular space)
2) As appropriate based on drilling and subsurface conditions, thin drilling mud, if used, by circulating fresh water
3) Install stainless steel casing and screen interval in the borehole (see Paragraph 3.3.3)
4) Complete well installation (see Paragraphs 3.3.5 through 3.3.8)
5) Conduct well development (see Paragraph 3.3.9)
6) Conduct well performance testing (see Paragraph 3.4.1 only)
7) If well performance testing is acceptable to the Engineer, complete well construction (Paragraphs 3.6 through 3.9)
8) If performance testing is not acceptable to the Engineer, abandon the well and proceed to a new location specified by the Engineer (see paragraph 3.11)

3.3.3 Screen, Casing/Riser Pipe Placement

Screen and casing riser pipe shall be threaded together and placed in the boreholes as shown on the Contract Drawings. A sump shall be placed at the end of the screen for the extraction wells and monitoring wells, the bottom cap on the sump shall be flush threaded, with an O-ring seal, and compatible with the screen as shown on the Contract Drawings. The bottom of the screen shall be placed no deeper than shown on the Contract Drawings. The riser pipe shall extend upwards from the screen to an elevation appropriate for the surface completion. The screen shall not be dropped or allowed to fall uncontrolled into the borehole. Joints and fastenings shall be watertight, equipped with an O-ring seal, and flush-threaded. The extraction well shall be plumb and centered in the hole by the use of steel centralizers in accordance with Paragraph 3.3.4 – Centralizers. Temporary casing or other measures shall be used, as necessary, to prevent collapse of the boring against the screen and casing/riser pipe prior to placement of the filter pack and sealing materials. A loose fitted cap shall be installed on the top of the riser pipe until the final surface completion is complete.

3.3.4 Centralizers

Centralizers shall be located at the top of the screen, at the bottom of the screen, and at appropriate intervals (e.g., every 50 feet) on the extraction well riser casing to maintain a nominal annulus per the Contract Drawings and aid in keeping the well plumb and aligned. Centralizers shall be constructed of stainless steel.

3.3.5 Filter Pack Placement

After the screen and casing are installed, the filter pack material for the wells shall be placed into the borehole annulus, with approved filter pack material as shown on the Contract Drawings. Filter pack material for the wells shall be placed in the borehole so that 1-foot of the hole below the bottom of the screen is filled with approved filter pack material. After the screen and casing have been concentrically placed in the hole, the remaining filter pack shall be placed around the screen by filling the entire space between the screen and the wall of the borehole over the selected screened interval. The filter pack shall be installed using a tremie pipe and in a way that will not damage the well screen.

3.3.6 Bentonite/Sand Slurry

A bentonite/sand slurry seal as specified in Paragraph 2.4 – BENTONITE/SAND SLURRY shall be placed in the annular space above the filter pack as shown on the contract drawings. The bentonite/sand slurry seal shall be placed in a manner that completely fills the annular space and prevents bridging and collapse of the borehole wall against the well casing.

3.3.7 Cement/Bentonite Grout Placement

Cement/bentonite grout shall be placed using a tremie pipe having an inside nominal diameter of not less than 1 inch. The grout shall be permitted to set for a minimum of 24 hours before development activities begin. The grout seal shall be placed in a manner that completely fills the annular space to a depth of 5 feet below the ground surface and prevents bridging and collapse of the borehole wall against the well casing. Additional grout shall be added from the surface to maintain the level of the grout as settlement occurs.

3.3.8 Extraction Well Development

The contractor shall determine the development method for the wells. The selected development method shall conform to industry standards and implemented to develop the entire length of the well screen as to best allow for efficient groundwater flow between the aquifer and the well. The Contractor shall identify the proposed method and the bid shall include the estimated investigation derived waste for the proposed method. Each well shall be developed within 7 days of completion of each extraction well but no sooner than 24 hours after cement grouting is completed. The extraction wells shall also be developed prior to conducting the performance testing. A development record shall be maintained in accordance with

Paragraph 1.8.3 – Well Development Records. Final well development pumping rates shall be 120% of the design flow rates listed in Paragraph 3.4.2.3. During previous well installation at this site the Engineer has found that it was useful to develop the well before pumping.

3.3.8.1 The development process shall continue until the water pumped from the well is sand-and-silt-free, the acceptance criteria are met, and maximum specific capacity has been attained.

3.3.8.2 Temperature, specific conductance, and pH readings should be measured before development starts, twice during, and twice after development operations have stabilized. Stabilization shall mean variation of less than ±10 percent change in temperature, pH, and specific conductance measured between three consecutive readings with one casing volume of water removed between each reading. Turbidity shall be measured, in accordance with the manufacturer's instructions, using a properly calibrated field portable turbidimeter and shall be less than 50 NTU. Temperature, conductivity and pH shall be measured using properly maintained and calibrated field portable instruments in accordance with the manufacturer's instructions. Development of extraction wells will proceed after these criteria are met to ensure these wells meet their performance requirements.

3.3.8.3 At the end of well development, records of maximum yields and final specific capacity must be recorded and shall become part of the well development record.

3.3.8.4 Sand Content

Following the completion of well development and before step testing, the extraction wells shall be pumped at a rate equal to 120% of the desired production rates listed in Paragraph 3.4.2 – Step Drawdown Testing. After pumping at this rate for 2 hours, the sand content shall not exceed 5 milligrams per liter (mg/L) of sand as determined from a sample of water representative of the entire flow in the discharge line. Sand content is defined by the dry weight of material retained by the #200 sieve per volume of water. If the sand content is still greater than 5 mg/L then development shall resume for another 2 hours. After additional development the sand content test will be repeated by pumping the well for one hour and then checking the sand content again. If after this additional hour of pumping, the sand content still exceeds the 5 mg/L level, or if the well is unable to produce at least the desired production rate, the Engineer shall be contacted for further direction.

3.3.8.5 At the completion of well development and after the sand content is acceptable to the Engineer, approximately 1 pint of well water shall be collected in a clear glass jar. The jar shall be labeled with project name, well number and date; and photographed. The photograph (minimally 5 x 7 inch) shall be a suitably backlit close-up which shows the clarity of the water and any suspended sediment. The digital photograph shall become a part of the well development record.

3.3.9 Monitoring Well Development

Within 7 days of completion of each monitoring well, but no sooner than 24 hours after cement grouting is completed, the well shall be developed. Monitoring well screens shall be developed in 2- or 3-foot intervals from bottom to top to ensure proper packing of the filter pack. Monitoring well development shall continue until water is clear and free of suspended solids as determined by a turbidity meter or when pH, conductivity, and temperature have stabilized, and the well is responsive to water level changes. A well development record shall be prepared for each well installed. Development of the monitoring wells will be considered complete when a relatively sediment-free and visually clear discharge is achieved and the pH, temperature, specific conductivity and turbidity remain consistent within a +/- 10 percent range. The goal is to achieve a turbidity reading of 50 nephelometric turbidity units (NTU) or below.

3.3.10 Handling of Development Water and Drill Cuttings

3.3.10.1 The liquid fraction of drilling mud, water generated during drilling, well development, decontamination, well disinfection, step testing, sustained yield testing, and any other activities shall be treated onsite using a temporary treatment system provided by the Contractor and discharged to storm sewer in accordance with the site NYSPDES permit equivalent. Drill cuttings and drilling mud shall be separated into liquid and solid fractions using appropriate methods such as a de-sander. The solid and liquid fractions will be contained in appropriate roll off containers or 21,000 gallon tanks. The liquid fraction of the drilling mud shall be contained with other water generated during well drilling, development, and testing. If used, drums shall be staged on wooden pallets and shall be properly labeled with the date, drum contents and site name. The pallets used to stage the drums shall be in good condition and shall be of sufficient strength to support the drums. The cuttings shall be staged onsite, sampled, and disposed of in accordance with all local, State and Federal regulations. Staged drums shall be labeled to identify the borehole/well identification and the date the drum was filled. All waste containers and waste disposal shall be the responsibility of the Contractor.

3.3.10.2 Containers used to store water or cuttings may be kept at site locations only while activities are being performed at the respective site locations. Otherwise the containers must be staged at an onsite central staging location.

3.4 WELL TESTING

3.4.1 Plumbness and Alignment Testing

3.4.1.1 The plumbness and alignment test shall be conducted in the presence of the Engineer no sooner than 24 hours after each extraction well construction is completed. The alignment test shall consist of slowly lowering a 20-foot length of pipe into the well down to the top of the well screen. The outside diameter of the pipe shall be 0.5 inches smaller than the inside diameter of the casing/riser pipe. Casing/riser pipe misalignment resulting in failure of the pipe to pass freely through any part of the entire length of the casing/riser pipe and screen shall be corrected at no additional cost to the Government. If casing misalignment cannot be corrected, the well will be disapproved by the Engineer and replaced at no additional cost to the Government.

3.4.1.2 The alignment and plumbness tests shall be documented on the well installation diagram that is described in Paragraph 1.8 – DOCUMENTATION AND QUALITY CONTROL REPORTS of this specification.

3.4.2 Step Drawdown Testing

3.4.2.1 To ensure that functioning extraction wells have been installed and determine each extraction well capacity, an 8-hour step drawdown pump-test shall be performed for each well.

The extraction wells shall be performance tested within 1 week after well development so the information can be used for the treatment system design. If the well does not meet the performance criteria, the Engineer shall be contacted for further direction. Step drawdown testing shall be completed before the well heads are completed. The Contractor shall supply all equipment, tools, supplies, and labor required to complete step testing including a power supply for the pumps.

3.4.2.2 The Contractor shall install a temporary pump in each well to determine the well's maximum yield and specific capacity. At wells EW-01S and EW01I the pump (or pumps) supplied must be capable of producing a flow rate ranging from 30 gpm to 80 gpm (133% of 60 gpm). At well EW-01D the pump supplied must be capable of covering a range of flow rates from 40 gpm to and up to 140 gpm (175% of 80 gpm). The Contractor assumes all liability for damage to the pump from sand entering the well. The Contractor shall furnish accessories necessary to accurately measure the flow from the pump up to twice the rate desired for the well. A mechanical instantaneous reading flow meter and a mechanical totalizing flow meter shall be used. The flow meters shall be calibrated prior to use and at the termination of the project. The piping or tubing used to convey water from the pump shall be fitted with a sampling port before the flow meters. All results shall be summarized and submitted to the Engineer for approval. Water removed during the performance testing shall be disposed of as described in Paragraph 3.3.10 – Handling of Development Water and Drill Cuttings.

3.4.2.3 The pump used during testing shall be located at the final design elevation as shown on the Contract Drawings. The estimated maximum flow rate for the extraction wells are listed below. Prior to the start of pumping the static water level shall be measured in each well. Pumping shall commence at a constant rate equal to 0.5 times the estimated maximum flow rate for each extraction well and shall continue for 2 hours. Water levels in the well shall be measured and recorded during the test, at a minimum, every minute for the first 10 minutes, every 5 minutes for 10 to 30 minutes, and every 10 minutes for 30 to 120 minutes. Immediately following this step (Step 1), three additional steps shall be conducted. At wells EW-01S and EW-01I the flow rates will be 0.80 (Step 2), 1.0 (Step 3), and 1.33 (Step 4) (in that order) times the estimated maximum flow rate, if the well has sufficient capacity to produce at those rates for the required time (120 minutes each Step). At well EW-01D the flow rates will be 0.80 (Step 2), 1.33 (Step 3), and 1.75 (Step 4) (in that order) times the estimated maximum flow rate, if the well has sufficient capacity to produce at those rates for the required time (120 minutes each Step). During each step the Contactor shall maintain constant flow rate without regard to changes in drawdown. During the first 15 minutes of the test the individual well flow rates (in gallons per minute) shall be monitored continuously and adjusted as needed to establish and maintain a constant flow rate. The individual well flow rates and the totalizer readings (in gallons) will be recorded at 15 minute intervals or less throughout the pumping phase. The water level in the well shall be recorded as prescribed for Step 1 for Steps 2 and greater. If the pump breaks suction at a pumping rate prior to the 2 hours, subsequent steps at higher rates need not be attempted. However, the flow rate shall be reduced until the water level while pumping stabilizes at least 5 feet above the pump intake and the test continued for the remainder of the 2 hours.

Extraction Well	Estimated Average Flow Rate (gpm)
EW-01S	60
EW-01I	60
EW-01D	80

3.4.3 Sustained Yield Test

3.4.3.1 Following completion of the Step Drawdown Testing (Paragraph 3.4.2 – Step Drawdown Testing) the results will be reviewed by the Engineer. If the results indicate that the target flow rates can be achieved then the Contractor will proceed with the sustained yield test. One goal of the sustained yield test is to measure the drawdown in the extraction wells and nearby monitoring wells caused by simultaneous pumping in all three extraction wells. A 72-hour sustained yield test shall be performed. The test shall begin within 1 week after well step testing is completed so that the information can be used for the treatment system design. The Contractor shall supply all equipment, tools, supplies, and labor required to complete step testing including a power supply for the pumps.

3.4.3.2 The Contractor shall install a temporary pump in each the well. The Contractor assumes all liability for damage to the pump from sand entering the well. The Contractor shall furnish accessories necessary to accurately measure the flow from each pump up to twice the rate desired for the well. A mechanical instantaneous reading flow meter and a mechanical totalizing flow meter shall be used. The flow meters shall be calibrated prior to use and at the termination of the project. The piping or tubing used to convey water from the pump shall be fitted with a sampling port before the flow meters. All results shall be summarized and submitted to the Engineer for approval.

3.4.3.3 The pump used during testing shall be located at the final design elevation as shown on the Contract Drawings. The estimated maximum flow rate for the extraction wells are listed in Paragraph 3.4.2 – Step Drawdown Testing.

3.4.3.4 The pumping will be maintained at a constant rate throughout the test (within +/- 5% of the target flow rate). The pumping phase of the test will run for 72 hours and will be followed by a recovery phase of 24 hours. The Contractor shall maintain a record of the start and stop time for each pump and the individual well pumping rates throughout the test. A mechanical instantaneous reading flow meter and a mechanical totalizing flow meter shall be used. The flow meters shall be calibrated prior to use and at the termination of the project. Water levels in the well shall be measured and recorded during the test, at a minimum, every minute for the first 10 minutes, every 5 minutes for 10 to 30 minutes, and every 10 to 15 minutes thereafter until the test is completed. During the test the Contactor shall maintain constant flow rate without regard to changes in drawdown. During the first 15 minutes of the test the individual well flow rates (in gallons per minute) shall be monitored continuously and adjusted as needed to establish and maintain a constant flow rate. The individual well flow rates and the totalizer readings (in gallons) will be recorded at 15 minute intervals or less throughout the pumping phase.

3.4.3.5 Two weeks before the test, transducers with built in data loggers will be deployed in the three extraction wells and in monitoring wells MW-01S, MW-01I, GWX-10019, and GWX-10020 to provide continuous water level data to establish the pre-test background conditions. The instruments shall be set to record water levels at 5 minute intervals on a linear time scale. The day before the start of the test the water level data will be downloaded from the transducers. The day before the start of the test a synoptic round of water levels will be collected from the three extraction wells and from monitoring wells MW-01S, MW-01I, MW-02S, MW-02I, MW-03S, MW-03I, GWX-10019, GWX-10020, SVP-03, SVP-04, and SVP-05. During the pumping and recovery phases water level data will be collected from each extraction well and from monitoring wells MW-01S, MW-01I, GWX-10019, and GWX-10020 and SVP-04.

3.4.3.6 Water level data shall be collected continuously from the extraction wells and monitoring wells MW-01S, MW-01I, GWX-10019, and GWX-10020 using programmable water level transducers. Monitoring wells SVP-03, SVP-04, and SVP-05 are multilevel Westbay wells. The Contractor shall provide one set of the necessary Westbay equipment to perform manual observations of water levels on these monitoring wells. The Westbay equipment must be operated by an individual trained by Westbay to operate this equipment.

3.4.3.7 The transducers will be programmed to collect water level data on a logarithmic time scale at the start of the pumping phase. Similarly, the transducers will be programmed to restart data collection using a logarithmic time scale at the start of the recovery phase. For example, during the first 10 minutes of pumping observations will be made a minimum of every minute, after 10 minutes observations will be made a minimum of every 10 minutes, after 100 minutes observations will be made a minimum of every 100 minutes, and after 1,000 minutes observations will be made a minimum of every 1,000 minutes (out to 4,000 minutes). During the pumping and recovery phases it will not be possible to monitoring all zones at the same time in multiport monitoring well SVP-04. Instead the Westbay transducer will have to be run up and down the borehole to collect data from each Westbay port. The Contractor will use Westbay monitoring equipment to collect data on a practical schedule to approximate the logarithmic sampling schedule discussed above.

3.4.3.8 Water produced during the sustained yield test will be disposed of as described in Paragraph 3.3.10 – Handling of Development Water and Drill Cuttings.

The Contractor shall report all pumping rate and water level data to the Engineer.

3.5 WATER QUALITY SAMPLING

Three sets of water quality samples will be collected from each extraction well for analysis of VOCs, and iron and manganese. The first set of samples will be collected from each extraction well at the conclusion of step testing described in Paragraph 3.4.2 – Step Drawdown Testing. The second set of samples will be collected from each extraction well at the during the yield test described in Paragraph 3.4.3 – Sustained Yield Test. The third set of samples will be collected from each extraction well at the conclusion of the yield test described in Paragraph 3.4.3 – Sustained Yield Test. Immediately before sample collection, the contractor shall measure the pH, specific conductance, oxidation potential, temperature (Celsius), dissolved oxygen, and turbidity of the water. The sample shall be preserved, packaged, and transported to the laboratory in accordance with SECTION 01450 – CHEMICAL DATA QUALITY CONTROL. The sample shall be maintained under a chain-of-custody at all times. The results of the analysis and a copy of the chain-of-custody shall be supplied to the Engineer.

3.6 BOREHOLE DISINFECTION

After development, testing, and sampling have been completed, each extraction well shall be disinfected using a chlorine solution of such volume and strength and so applied that a concentration conforming to AWWA C654-03 be obtained in all parts of the extraction wells. The chlorine shall be prepared and applied in such a manner as will meet AWWA C654-03. An appropriate tremie device shall be employed to ensure proper distribution of the disinfectant.

3.7 LEVEL TRANSDUCERS

3.7.1 Extraction Wells

A level transducer shall be installed in each extraction well and shall be set 5 feet above the intake of the pump as shown on Contract Drawing Sheet 5. A rigid Polyvinyl chloride (PVC) perforated drop tube shall be utilized to protect the transducers.

3.7.2 Monitoring Wells

A level transducer shall be installed in monitoring wells MW-01S, MW-0I, MW-02S, MW-02I, MW-03S, and MW-03I.

3.8 WELL CAPS, PROTECTIVE CASING, AND ID TAGS

3.8.1 Extraction Wells

3.8.1.1 The extraction well casings shall be finished 2 to 3 feet below the land surface and enclosed in an insulated water tight well vault as shown on the Contract Drawings. Each vault shall have a locking vault door flush with the ground surface. Each vault shall be insulated to prevent freezing of the interior piping. The well vaults shall be pre-cast or cast-in-place concrete constructed with rebar in accordance with the DIVISION 3 – CONCRETE SPECIFICATIONS. Alternate materials of construction will be acceptable.

3.8.1.2 A concrete apron shall be constructed around the well vault and sloped to facilitate runoff away from the vault as shown on the on the Contract Drawings.

3.8.2 Monitoring Wells

3.8.2.1 Each monitoring well casing shall be fitted with an expandable rubber seal-locking cap and a lockable steel cap. The final surface completion of each well, as detailed below, may be changed by the Engineer based on field conditions.

3.8.2.2 Each well shall be equipped with a 4-inch well casing finished at grade. The well shall be fitted with a flush mount protective casing as shown on the Contract Drawings. The inner locking cap shall be secured with identical locks and keys. A permanent well ID tag shall be attached to the well cap or inside of the protective casing. The ID-tag shall include the well name, open interval and date completed. The Engineer will supply information for the well ID tag to the Contractor. Keyed-alike padlocks for the well caps shall be provided for the extraction and monitoring wells.

3.8.3 Monitoring Well Pad

Each monitoring well shall have a concrete pad of at least 4 inches in thickness at the outside edge, formed at the surface with 2-inch by 4-inch boards, and poured around it in a 3-foot square to seal the protective casing in place. The concrete pad shall slope away from the outside of the protective casing, to facilitate runoff away from the well. After the pad is cured, the form shall be removed and the adjacent land surface raked/filled so that the edge of the top of the pad is flush with the adjacent land surface.

3.9 SURVEYS

Coordinates and elevations shall be established for each extraction and monitoring well after completion. Horizontal coordinates shall be determined to the closest 0.1 foot and referenced to the New York State Plane Coordinate System, Long Island Zone, NAD83. A ground elevation to the closest 0.01-foot shall be obtained at each well. The highest point on the top of the riser pipe shall serve as the measuring point (for depth to water readings) and shall be permanently and clearly marked. The elevation of the measuring point shall be surveyed to the nearest 0.01 foot and referenced to NAVD88.

3.10 TEST BORING AND WELL ABANDONMENT

3.10.1 Any test boring or well disapproved by the Engineer, or any test boring or well abandoned by the Contractor for any reason shall be abandoned according to the requirements of the State of New York and the requirements of these specifications.

3.10.2 If the well is installed as part of this specification and it is necessary to abandon it, the Contractor shall attempt to remove the well casing, screen, and any other material in the hole (excluding the filter pack and backfill materials) before abandoning the well. The well shall then be abandoned by pumping grout into the well or borehole from the bottom to the top via a tremie pipe installed to the bottom of the hole in accordance with NYSDEC requirements for well abandonment and following the protocol for grout/bentonite placement established in Paragraph 3.3.8 – Cement/Bentonite Grout Placement, using the grout mix specified in Paragraph 2.5 – Cement/Bentonite Grout. Material removed from the well may be decontaminated and reused at the direction of the Engineer. If not reused the material must be properly disposed of by the Contractor.

3.10.3 Wells and test borings abandoned for any reason shall be grouted from the bottom to within 2 feet of the top of the ground. If present, the protective casing and well casing shall be cut off 2 feet below ground surface. The top 2 feet of the borehole shall then be backfilled with material appropriate for the intended land use.

3.10.4 The Contractor shall maintain a well abandonment record as specified in Paragraph 1.8.4 – Well and Test Boring Abandonment Records. Groundwater levels, if encountered before the decision is made for abandonment, shall be measured in all borings prior to backfilling. These water levels shall be included in the well abandonment records. No well shall be abandoned without the approval of the Engineer.

3.11 WELL ACCEPTANCE

It is the responsibility of the Contractor to properly design, construct, install, and develop all wells according to the requirements of this specification so that they are suitable for the intended purpose. If the Contractor installs wells that are not functional or not in accordance with these specifications, the Engineer will disapprove the well and direct the Contractor to repair or replace it at no additional cost to the Government, and or abandon the disapproved well in accordance with this specification.

3.12 EXTRACTION WELL OPERATION AND MAINTENANCE (O&M)

O&M of the extraction and monitoring wells shall be performed in accordance with SECTION 01851- WELL MAINTENANCE PROGRAM and the approved O&M Manual.

END OF SECTION

SECTION 02576

PAVEMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall provide the necessary equipment, labor and materials required and perform all work in connection with the construction of pavement as shown on the Drawings and as specified herein. This Section includes the restoration of pavement removed as part of the installation of influent/effluent pipes, and installation of new access road as shown on the Contract Drawings.

1.1.2 The Contractor shall be responsible for repairing all incidental damage and settlement which occurs in affected areas (trenching) as a result of construction activities. Materials and labor to complete all repair work, will be in accordance with all local codes and ordinances.

1.2 RELATED WORK

Backfilling and compaction are to be completed in accordance with SECTION 02300 - EARTHWORK.

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Certified Mix Designs; Pre-Construction Submittals; EA

1.3.2 Certified Test Results for Gravel Gradation; Design Data; FIO

1.4 REFERENCES

In addition to complying with all pertinent codes and regulations, comply with the referenced or applicable portions of the Updated 2006 Standard Specifications (Dated May 2006) of the New York State Department of Transportation herein referred to as "NYSDOTSS".

1.5 PRODUCT HANDLING

1.5.1 Protection

1.5.1.1 Use all means necessary to protect bituminous concrete pavement materials before, during and after installation and to protect the installed work and materials of all other trades.

1.5.1.2 Replacements

1.5.1.2.1 In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer. Repairs are to be made in a manner to insure restoration of a uniform surface and durability of the part repaired. Faulty and damaged work, regardless of cause, shall be replaced for the full depth of the course.

PART 2 PRODUCTS

2.1 BASE COURSES

2.1.1 Sub-base Course

The gravel sub-base course shall be installed in accordance with Section 304 of the NYSDOTSS and as shown in the Contract Drawing. The material shall be selected from one of the four options as specified in Section 304 of the NYSDOTSS.

2.1.2 Bituminous Concrete Base Course

The bituminous stabilized base course shall be hot mix asphalt (HMA), mixed and placed in conformance with the materials and construction details specified in Section 402 of the NYSDOTSS and as shown in the Contract Drawing.

2.2 BITUMINOUS CONCRETE SURFACE COURSE

The bituminous concrete surface course shall be HMA, Type 6, mixed and placed in conformance with the materials and construction details specified in Section 403 and as shown on the Contract Drawing.

2.3 TACK COAT

The tack coat material shall be, Asphalt Emulsion Tack Coat in accordance with the requirements of Section 702-90 of the NYSDOTSS.

PART 3 EXECUTION

3.1 WEATHER LIMITATIONS

3.1.1 Bituminous tack coat shall be applied only when the ambient temperature in the shade is above 50 degrees F or when the temperature has not been below 35 degrees F for 12 hours immediately prior to application. Application may commence when the aggregate base course is dry or contains moisture not in excess of the amount that will permit uniform distribution and the required penetration.

3.1.2 The bituminous concrete mixture shall not be placed upon a wet surface, in rain, or when the surface temperature of the underlying course is less than 50 degrees F. In addition surface course shall not be placed when the air temperature is less than 40 degrees F. Once the bituminous concrete mixture has been placed and if rain is imminent, protective materials, consisting of rolled polyethylene sheeting at least four mils thick of sufficient length and width to cover the mixture shall be placed.

3.2 STORAGE OF MIXTURE

The open graded bituminous mixture shall not be stored for longer than one hour prior to hauling to the site.

3.3 TRANSPORTATION OF MIXTURE

Transportation from the mixing plant to the site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of mixture to truck bodies. Diesel fuel shall not be used as a releasing agent. Excessive release agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from the weather and to prevent loss of heat. In cool weather or for long hauls, the entire contact area of each truck bed shall be insulated. Covers shall be securely fastened. Loads that have crusts of cold, unworkable material or have become wet will be rejected. Hauling over freshly placed material will not be permitted.

3.4 SURFACE PREPARATION OF UNDERLYING COARSE

Prior to placing open graded bituminous mixture, the underlying coarse shall be cleaned of all foreign or objectionable matter with power brooms and hand brooms. Ruts or soft, yielding spots in the subgrade shall be loosened and removed and approved materials shall be backfilled, reshaped and compacted to meet the final grade requirements. At the time of base course construction, the subgrade or subbase course shall contain no frozen material.

3.5 TACK COATING

3.5.1 Contact surfaces of subbase course, curbs, manholes catch basin, and other structures projecting into or abutting the bituminous concrete pavement shall be coated with a thin, uniform coating of bituminous tack-coat material prior to the bituminous-concrete mixture being placed against such structures. The application rate of the cut-back asphalt or the emulsified asphalt shall be in accordance with Section 407 of NYSDOTSS. Care shall be taken to avoid getting tack or prime material on surfaces which will not come in contact with pavement.

3.5.2 Following the application of the tack coat, the surface shall be allowed to dry until it is in a condition of tackiness, to receive the bituminous-concrete mixture. Excess tack-coat material shall be squeegeed from the surface.

3.6 PAVEMENTS

3.6.1 General

3.6.1.1 The Contractor shall not use or operate equipment which may cut or damage the surface of the existing paved surfaces which are not subject to removal or restoration.

3.6.1.2 Where new pavements adjoins existing paved areas, existing pavement shall be cut to a line, where existing pavement is to be built upon, or trenched, all cutting of existing pavement shall be to a line.

3.6.1.3 New pavement shall meet the grade of the existing pavement or the designated grade.

3.6.1.4 Compaction of sub-base course materials, application, distribution and compaction for the base course, and placement of leveling course and surface course shall be accomplished with such type and size of equipment as is necessary to accomplish the work, and as approved by the Engineer.

3.6.1.5 At the completion of pavement installation the Contractor shall install crack sealer over all joints.

3.6.2 Sub-grade

3.6.2.1 The Contractor shall be required to place material selected for pavement sub-grade in all trenches. All such trenches shall be maintained by the Contractor during the period of trench activity. The contractor shall use barricades, lights and adequate signs to indicate that the trench is soft, and if settlement occurs in the trench, immediately restore the pavement to the required grade.

3.6.2.2 All sub-grade shall be made smooth and even to match the existing grade of the asphalt pavement. Sub-grade shall be compacted by rolling using a tandem roller weighing not less than 3 tons. Where it is not practical to use a roller, mechanical or hand-tamping methods may be employed, subject to the Engineer's approval.

3.6.3 Subbase

3.6.3.1 Placing

The sub-base course shall be spread in the required quantity and shaped so that when compacted and finished it will be of the thickness and at the required grade. Frozen material shall not be used.

3.6.3.2 Compaction

The sub-base course shall be compacted to 95 percent of maximum dry density in accordance with Section 203-3.12 of NYSDOTSS.

3.6.4 Base Course

3.6.4.1 Placing

3.6.4.1.1 Bituminous concrete base course shall be applied over asphalt tack coating to the compacted depth. The Contractor shall be responsible for securing a source and mix formula for the materials that will be acceptable to the Engineer.

3.6.4.1.2 Tack coating shall be applied to the entire new sub-base and cut edge of the adjoining pavement at the rate specified in Section 407, Table 407-1 of NYSDOTSS. The bituminous concrete base course shall be placed, spread and compacted to the required lines and levels within allowances for surface course material.

3.6.4.1.3 The Contractor shall receive the Engineer's approval for the type of compaction equipment and method of use. In addition, the Contractor shall take all necessary precautions relative to weather, temperature, materials delivery schedules and other conditions that might adversely affect the work.

3.6.4.2 Compaction

The bituminous stabilized base shall be compacted as required by Subsection 402-3.07 of the NYSDOTSS except that test strips and comparison strips will not be required.

3.6.5 Surface Course

Surface course shall be applied over asphalt tack coat to the compacted depth. Surface course shall be finished level with adjoining existing pavements, pitched and sloped as necessary to prevent standing water.

3.7 JOINTS

Joints shall have the same texture, density and smoothness as other sections of the course. Joints between old and new pavements, or between successive days work, shall be made to ensure a continuous bond between the old and new section of pavement. The edge of the previously placed course shall be cut back to expose an even vertical surface over the full thickness of the course.

3.8 PATCHING DEFICIENT AREAS

3.8.1 Bituminous-concrete mixtures that become mixed with foreign material or that are defective, such as low areas or "bird-baths", shall be removed, replaced with fresh bituminous-concrete mixture to obtain the required grade and smoothness for the finished surface and compacted to the specified density.

3.8.2 Pavement in deficient areas shall be removed to the full thickness of the bituminous-concrete course and so cut that the sides are perpendicular and parallel to the direction of traffic and the edges are vertical. Edges shall be sprayed with bituminous tack-coat material.

3.8.3 Skin patching an area that has been rolled will not be permitted.

END OF SECTION

SECTION 02821

FENCING

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall furnish all labor, equipment, materials and incidentals necessary to install the fence and as shown on the Contract Drawings and specified herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 392	Zinc-Coated Steel Chain-Link Fence Fabric
ASTM C 94	Ready-Mixed Concrete
ASTM F 626	Fence Fittings
ASTM F 883	Padlocks
ASTM F 900	Industrial and Commercial Swing Gates
ASTM F 1043	Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

NEW YORK STATE DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATION (NYSDOTSS)

NYDOTSS, Section 607	Fence

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Fencing; Shop Drawings; EA

Submit to the Engineer for approval, shop drawings showing layout and details of construction and erection of fencing, gates and accessories required. Drawings shall show post sizes and sections; post setting and bracing; gate details; details of attachment of fabric to support members; and any other details required to erect the fence along the lines indicated on the Contract Drawings. Manufacturer's product data shall be submitted for each type of fence to be used indicating conformance to the below specified product requirements.

1.3.2 Material Certificates; Certificates; FIO

Submit to the Engineer statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the fences and related components meet the specified requirements.

PART 2 PRODUCTS

2.1 CHAIN LINK FENCE

Chain link fence shall meet the requirements specified herein and also those provided in NYSDOTSS, Section 607.

2.1.1 Fabric

Chain link fence fabric shall conform to the requirements of ASTM A 392 for Class 1 zinc-coated steel wire. It shall have a minimum coating weight of 1.2 ounces of zinc per square foot of coated surface. Fabric shall be fabricated of 9-gauge wire woven in 2-inch mesh. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage. Fabric height shall be as shown on the Contract Drawings.

2.1.2 Gates

Gates shall be of the type, size, and swing shown on the Contract Drawings, and shall meet the requirements of ASTM F 900. Gate frames shall conform to the strength and coating requirements of either ASTM F 1043 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) of 1.5 inches. Gate fabric shall be as specified for chain link fence fabric. Gate leaves more than 8 feet wide shall have either intermediate members or diagonal truss rods to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding shall not be permitted. Gates shall be furnished with all latches, hinges, stops, keepers, rollers, and other hardware required for proper operation. Latches shall be arranged for padlocking, when so required, so that the padlock will be accessible from both sides of the gate regardless of the latching arrangement. Stops shall be provided for holding the gates in the open position.

2.1.3 Posts

Line posts and terminal posts shall be hot dipped galvanized conforming to ASTM F 1083. Line posts and terminal posts shall be size NPS of 2 inches and 3 inches, respectively. Posts shall meet the strength and coating requirements of ASTM F 1043 for Group IA posts, with external coating Type A steel pipe. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the requirements in ASTM F 900.

2.1.4 Braces and Top Rails

Braces and top rails shall be hot dipped galvanized, steel pipe, size NPS 1.25 inches conforming to ASTM F 1043, Group IA.

2.1.5 Accessories

Fence accessories shall conform to the requirements of ASTM F 626. Ferrous accessories shall be hot dipped galvanized steel. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment.

2.2 CONSTRUCTION FENCING

Construction fencing shall be orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts anchored in the ground and spaced a maximum distance of 10 feet on center.

2.3 CONCRETE

Concrete, in accordance with ASTM C 94, shall be mixed using 3/4-inch maximum-size aggregate, and having minimum compressive strength of 3000 pounds per square inch (psi) at 28 days, in accordance with the requirements of SECTION 03300 - CAST-IN-PLACE CONCRETE. Grout shall consist of one part Portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.4 PADLOCKS

Padlocks shall be keyed alike, per property, and each lock shall be furnished with two keys and meeting ASTM F 883, Type P01, Grade 2, 1-3/4 inch.

PART 3 EXECUTION

3.1 GENERAL

Fence shall be installed in accordance with the dimensions, lines, and grades shown on the Contract Drawings. The fence surrounding the treatment facility building shall be offset at least 15 feet from the building.

3.2 EXCAVATION

Post holes shall be cleared of loose material. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 2-inch clearance between the bottom of the fence and finish grade.

3.3 INSTALLATION

3.3.1 Posts

3.3.1.1 Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet.

3.3.1.2 Posts shall be set plumb and in alignment. Except where solid rock is encountered, chain link fence posts shall be set in concrete to the depth of 28 inches. All other posts shall be set in the ground as shown on the Contract Drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock. Where solid rock covered with an overburden of soil or loose rock, posts shall be set to the minimum depth of 28 inches unless a penetration of 18 inches in solid rock is achieved before reaching the 28 inch depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Terminal posts set in concrete shall be set in holes not less than 12 inches in diameter. Line posts set in concrete shall be set in holes not less than the 10 inches in diameter. Diameters of holes in solid rock shall be at least one inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of three feet and shall be protected with drive caps when being set.

3.3.2 Top Rail

Top rails shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail. Top rails of stockade and picket fences shall be nailed.

3.3.3 Braces and Truss Rods

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal braces and diagonal truss rods shall be installed on fences over six feet in height. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences six feet high or less if a top rail is installed.

3.3.4 Chain Link Fabric

Chain link fabric shall be installed on the side of the post indicated on the Contract Drawings. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15-inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15-inch intervals and fastened to all rails and tension wires at approximately 24-inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 2 inches, plus or minus a half inch, above the ground.

3.3.5 Construction Fencing

Construction fencing shall be installed along the entire perimeter of construction area and exclusion zones prior to the commencement of work. The Contractor shall maintain the structural integrity of such fencing until the completion and acceptance of site restoration for a given area. Upon acceptance of work, the construction fencing shall become the property of the Contractor and shall be removed from the site.

3.3.6 Gates

The Contractor shall provide at least one vehicle access gate and one pedestrian gate at the treatment system building. Hinged gates shall be mounted to swing inward or outward to match the original and as indicated on the Contract Drawings. Latches, stops, and keepers shall be installed as required.

Padlocks shall be attached to gates or gate posts with chains. Hinge pins and other hardware shall be secured to prevent removal.

END OF SECTION

SECTION 02900

SITE RESTORATION

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, equipment, material, and incidentals necessary to restore the site as specified herein and/or as directed by the Engineer.

1.1.2 The Contractor shall furnish all labor, equipment, materials and incidentals necessary to place topsoil, finish grade, apply lime and fertilizer, and apply seed for all disturbed areas except as otherwise specified herein. The Contractor shall furnish all labor, equipment, materials and incidentals necessary to provide erosion control as specified in SECTION 02370 - SOIL EROSION CONTROL.

1.1.3 The Contractor shall perform work in accordance with the New York State Standards and Specifications for Erosion and Sediment Control, August 2005.

1.1.4 Paved access road shall be constructed from Clinton Road to the groundwater treatment building as shown on the Contract Drawing and in accordance with SECTION 02576 - PAVEMENT. Pavement disturbed during trenching shall be restored in accordance with SECTION 02576 - PAVEMENT.

1.1.5 The Contractor shall construct 30 feet by 50 feet gravel area by the groundwater treatment building as shown on the Contract Drawing. The material shall meet the requirements of SECTION 02100 - SITE PREPARATION.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

<u>U.S. DEPARTMENT OF AGRICULTURE (USDA)</u>

USDA 01 Federal Seed Act of August 9, 1939 (53 Stat. 1275) Rules and Regulations

<u>NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC)</u>

New York State Standards and Specifications for Erosion and Sediment Control (August 2005)

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Material Certificates; Certificates; EA

The Contractor shall submit the certificates of compliance that materials meet the specified requirements, prior to the delivery of materials. Certified copies of the material certificates shall include the following:

- Seed: Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested
- pH Adjuster: Calcium carbonate equivalent and sieve analysis
- Fertilizer: Chemical analysis and composition percent

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Fertilizer

Fertilizer shall be commercial, mixed, free flowing granules or pelleted fertilizer, 10-20-10 (N-P205-K20) grade for lawn and naturalized areas. Fertilizer shall be delivered to the site in original unopened containers each showing the manufacturer's guaranteed analysis conforming to applicable state fertilizer laws. At least 40 percent of the nitrogen in the fertilizer shall be in slowly available (organic) form.

2.1.2 Lime

Lime shall be ground limestone containing not less than 90% calcium and magnesium carbonates and be ground to such fineness that at least 90% shall pass a 10-mesh sieve and at least 50% shall pass a 60-mesh sieve.

2.1.3 Temporary Seed Species

Temporary seedings may be necessary to provide cover when permanent seedings are likely to fail due to mid-summer heat or drought. Temporary seed species shall be as specified by NYSDEC according to season of installation.

2.1.4 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be as specified by NYSDEC. The general purpose seed mix (Mix #6) is suggested and listed below in Table 02900-1.

Table 02900-1
Permanent Seed Species and Mixtures

Variety	Common Name	Planting Rate (lbs/acre)
Ensylva, Pennlawn, Boreal	Creeping red fescue	60
KY-31/Rebel	Tall fescue	60
Pennfine, Linn	Perennial ryegrass	15
Empire, Pardee	Birdsfoot trefoil	30

2.1.5 Hay Mulch

Hay mulch shall consist of cured hay. When air dried in the loose state, the contents of a representative bale shall lose not more than 15 percent of the resulting air dry weight of the bale. It shall be free from primary noxious weed seeds and rough or woody materials.

2.1.6 Straw Mulches

Straw mulches shall be stalks from oats, wheat, rye, barley, or rice and shall be furnished in air-dry condition and with a consistency for placing with commercial mulch blowing equipment. Mulches shall be free from weeds, mold, and other deleterious materials, in addition to meeting the requirements of state regulations.

2.1.7 Erosion Control Material

Soil erosion control shall conform to materials specified in SECTION 02370 - SOIL EROSION CONTROL.

PART 3 EXECUTION

3.1 SEEDING TIME

Seed shall be sown from March 1 to May 15 or from August 15 to October 1 or as directed by the Engineer.

3.2 SITE PREPARATION

3.2.1 Preparation of Seeding Areas

3.2.1.1 Grading

The Engineer shall verify the finished grades as indicated on the Contractor's approved drawings, and that the placing of topsoil and the smooth grading has been completed in accordance with SECTION 02300 - EARTHWORK.

3.2.1.2 Unsatisfactory Environmental Conditions

Site preparation work shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed.

3.2.2 Application of Soil Amendments

3.2.2.1 Soil Test

A soil test shall be performed for pH, chemical analysis and mechanical analysis to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of turf specified.

3.2.2.2 Lime

Lime shall be applied at the rate in tons per acre, as recommended by the soil pH test for the following soil type:

Initial Soil pH	Sands	Sandy Loams	Loams and Silt Loams	Silty Clay Loams
4.5	1.25	3.0	4.75	6.5
4.6-4.7	1.25	3.0	4.5	6.25
4.8-4.9	1.25	2.75	4.25	6.0
5.0-5.1	1.0	2.5	3.75	5.25
5.2-5.3	0.75	2.0	3.25	4.25
5.4-5.5	0.5	1.5	2.0	3.0
5.6-5.7	0.5	1.0	1.5	2.25
5.8-5.9	0.35	0.75	1.25	1.75
6.0-6.1	0.3	0.75	1.0	1.5
6.2-6.3	0.2	0.5	0.75	1.0
6.4-6.5	0.15	0.35	0.5	0.75
6.6-6.7	0.1	0.25	0.35	0.5

Lime shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage operation.

3.2.2.3 Fertilizer

Fertilizer shall be applied as determined by the soil test. Fertilizer shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage.

3.2.3 Tillage

3.2.3.1 Minimum Depth

Soil shall be tilled to a minimum depth of 4 inches by plowing, disking, harrowing, rototilling or other method approved by the Engineer. On slopes 2 horizontal to 1 vertical and steeper, the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes, or other method approved by the Engineer. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1 horizontal to 1 vertical and steeper, no tillage is required.

3.2.3.2 Applying Lime and Fertilizer

Lime and fertilizer, as specified previously, may be applied during tillage.

3.2.4 Finished Grading

3.2.4.1 Preparation

Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on the Contractor's approved drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of erosion or grade deficiencies shall conform to topsoil requirements specified in SECTION 02300 - EARTHWORK. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

3.2.4.2 Debris

Lawn areas shall have debris and stones larger than 1 inch in any dimension removed from the surface.

3.2.4.3 Protection

Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

3.3 SEEDING

3.3.1 General

Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rains, traffic, or other cause, shall be reworked to restore the ground condition previously specified. Do not broadcast seed, or hydroseed, when the wind velocity is such as to prevent uniform seed distribution.

3.3.2 Applying Seed

3.3.2.1 Broadcast Seeding

Seed shall be uniformly broadcast at the rate of 3 pounds per 1000 square feet using broadcast seeders. Half of the seed shall be broadcast in one direction, and the remainder at right angles to the first direction. Seed shall be covered to an average depth of 1/4 inch by disk harrow, steel mat drag, cultipacker, or other approved device.

3.3.2.2 Drill Seeding

Seed shall be uniformly drilled to an average depth of 1/2 inch and at the rate of 3 pounds per 1000 square feet using equipment having drills not more than 6-1/2 inches apart. Row markers shall be used with the drill seeder.

3.3.3 Applying Mulch

Straw mulch shall be applied at a rate of 90 lbs per 1000 square feet. Fiber mulch shall be applied at a rate of 50 lbs per 1000 square feet. Mulch shall be anchored appropriately.

3.4 EROSION CONTROL

3.4.1 Temporary Turf Cover

When there are contract delays in the turfing operation, the areas designated for turf shall be straw mulched with a temporary seed mixture, and emulsified asphalt as previously specified, to prevent erosion as directed by the Engineer.

3.5 RESTORATION AND CLEAN UP

Excess and waste material shall be removed and disposed off the site. Adjacent areas shall be cleaned. Existing turf areas which have been damaged during the contract operations shall be restored to original conditions.

3.6 PROTECTION OF TURFED AREAS

Immediately after seeding, the area shall be protected against traffic or other use by erecting barricades and providing signage as required or as directed by the Engineer.

3.7 TURF ESTABLISHMENT PERIOD

3.7.1 Length of Period

On completion of the last day of the turfing operation, the Turf Establishment Period will be in effect or as directed by the Engineer.

3.7.2 The turf establishment period shall be a minimum of 12 weeks. The Engineer will inspect all work for provisional acceptance at the end of the turf establishment period.

3.7.3 Maintenance During Establishment Period

3.7.3.1 General

Maintenance of the turfed areas shall include eradicating weeds, protecting embankments and ditches from erosion, maintaining erosion control material, and protecting turfed areas from traffic.

3.7.3.2 Repair

Turf condition shall be reestablished as specified herein for eroded areas, damaged or barren areas. Mulch shall be repaired or replaced as required.

3.7.3.3 Mowing

Turfed areas shall be mowed to a minimum height of 3 inches when the average height of the turf becomes 5 inches. Clippings shall be removed when the amount of cut turf is heavy enough to damage the turfed areas.

3.7.3.4 Watering

Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 2 inches. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf. Run-off, puddling and wilting shall be prevented.

3.7.4 A satisfactory stand will be defined as follows:

3.7.4.1 No bare spots larger than 1 sq ft.

3.7.4.2 Not more than 10 percent of total area with bare spots larger than 6 sq inches.

3.8 FINAL ACCEPTANCE

At the end of the construction, a final inspection will be made in accordance with SECTION 01451 – CONTRACTOR QUALITY CONTROL. Final acceptance of the turf will be based upon a satisfactory stand of turf as defined in the Paragraph 3.7 - Turf Establishment Period. Rejected areas shall be replanted or repaired as directed by the Engineer.

3.8.1 The Contractor shall remove all equipment and materials used during the project operation including, but not limited to, trailers, hay bales, silt fence, construction fence, electrical wiring, decontamination pad, etc., prior to demobilization from the site.

3.8.2 Prior to demobilization, all equipment shall be decontaminated in accordance with procedures as specified in SECTION 01351 - SAFETY, HEALTH, AND EMERGENCY RESPONSE.

3.8.3 All materials removed during the site restoration activities shall be disposed of at an off-site disposal facility approved by the Engineer.

3.8.4 The Contractor shall vacate the site in an orderly manner and to the satisfaction of the Engineer.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, materials, equipment and incidentals required and design, install and remove formwork for cast-in-place concrete as shown on the approved drawings and as specified herein.

1.1.2 The Contractor shall secure to forms or set for embedment all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts, waterstops, fiberglass reinforced plastic components, and other items furnished under other Sections and required to be cast into concrete.

1.2 REFERENCES

The publication listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 30	Specifications for Structural Concrete for Buildings
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 347R	Guide to Formwork for Concrete

AMERICAN PLYWOOD ASSOCIATION (APA)

Material grades and designations as specified

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Detail Drawings; Shop Drawings; EA

The Contractor shall submit shop drawings indicating location on sequence of concrete placement, locations of joints, panel sizes and patterns, location of form ties.

The review of pour sequence, form system and panel layout shall be for appearance and strength of the completed structure only. Approval by the Engineer and structural engineer of record of these items shall not relieve the Contractor of the responsibility for the strength, safety or correctness of method used, the adequacy of equipment, or from carrying out the work in full compliance with the requirements of the Contract Drawings and specifications.

1.3.2 Form Design; Product Data; EA

Design analysis and calculations by the delegate engineer for form design and methodology used in the design. Memo from structural engineer of record indicating approval or "No exceptions taken" to the formwork design and methodology by the delegate engineer.

1.3.3 Form Materials; Product Data; EA

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

1.3.4 Form Releasing Agents; Samples; EA

The Contractor shall demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not adversely affect concrete surfaces to be painted, coated or otherwise finished and will not affect the forming materials.

1.3.5 Form Releasing Agents; Manufacturer's Instructions; FIO

Manufacturer's recommendation on method and rate of application of form releasing agent shall be followed.

1.3.6 Certificates; Certificates; FIO

Certify that form release agent is made for use in contact with potable water (non-toxic and taste and odor free). Certify that form release agent complies with Federal, State, and local volatile organic compounds (VOC) limitations.

1.4 DESIGN OF FORMS

The Contractor shall provide all forms and shoring designed by the delegate engineer, who is a professional engineer registered in the State of New York. Design and erect formwork shall be in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347R. The Contractor shall comply with all applicable regulations and codes and consider any special requirements due to the use of plasticized and/or retarded set concrete. Design and calculations shall be review and approved by the structural engineer of record and the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Forms, General

The Contractor shall make forms for cast-in-place concrete of wood or steel, except as specified in Paragraphs 2.1.2 and 2.1.3. Wood forms shall be constructed of sound lumber or plywood free from knotholes and loose knots. Steel forms shall be constructed to produce surfaces equivalent in smoothness and appearance to those produced by new plywood panels.

2.1.2 Forms for Exposed Concrete

2.1.2.1 Forms for all exposed and non-submerged exterior and interior concrete shall be made of new and unused Plyform exterior grade plywood panels manufactured in compliance with the APA and bearing the APA trademark. B grade or better veneer shall be provided on all faces to be in contact with concrete.

2.1.2.2 The Contractor shall provide rigid forms that will not deflect, move, or leak. Forms shall be designed to withstand the high hydraulic pressures resulting from rapid filling of the forms and heavy high frequency vibration of the concrete. Deflection shall be limited to 1/400 of each component span. Form joints shall be placed in a uniform pattern.

2.1.2.3 Dress and match boards. Plywood shall be sanded smooth and shall be fitted with adjacent panels with tight joints. Tape, gasket, plug, and/or caulk all joints and gaps in forms to provide watertight joints that will withstand placing pressures without exceeding specified deflection limit or creating surface patterns.

2.1.2.4 The Contractor shall provide forms for circular structures that conform to the circular shape of the structure and where applicable the existing structure below. Straight panels may be substituted for circular panels if the straight panels do not exceed 2 feet in width, nor deflect more than 3½ degrees per joint, nor conflict with specific notes indicated and panels conform with the existing structure below.

2.1.3 Form Release Agent

All form surfaces in contact with concrete shall be coated with an effective, non-staining, non-residual, water based, bond-breaking form coating unless otherwise indicated or specified. Form release agent made for use in contact with potable water, non-toxic and taste and odor free shall be used. Form release agent shall not impair the bond of paint, sealant, waterproofing, dampproofing, or other coatings.

2.1.4 Form Ties

2.1.4.1 Coil and Wire Ties: The Contractor shall provide ties manufactured so that, after removal of the projecting part, no metal remains within 1½ inches of the face of the concrete. The part of the tie to be removed shall be at least ½-inch diameter or be provided with a plastic or wooden cone at least ½-inch diameter and 1½ inches long. Cone washer type form ties shall be used in concrete exposed to view.

2.1.4.2 Flat Bar Ties for Panel Forms: Ties shall have plastic or rubber inserts with a minimum depth of 1½ inches and manufactured to permit patching of the tie hole.

2.1.4.3 Ties for liquid containment structures and exterior below grade basement walls shall have a steel waterstop tightly attached to each strut or a neoprene rubber washer on each strut.

2.1.4.4 Common wire shall not be used for form ties.

2.1.4.5 Alternate form ties consisting of tapered through-bolts at least 1 inch in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size may be used. Install in forms so that large end is, where applicable, on the liquid or backfilled side of the wall. Clean, fill and seal form tie hole with non-shrink cement grout. Contractor shall be responsible for water tightness of the form tie holes and make all repairs needed to make watertight.

2.1.4.6 Alternate form ties specified in Paragraph 2.1.4.5 may be used when forms are to be set against previously placed or existing concrete walls. Use in conjunction with cast-in threaded inserts or drilled-in threaded anchors so that no metal remains within expansion joint upon removal of tapered through bolt. Conform to requirements specified in Paragraph 2.1.4.5.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 The Contractor shall provide forms for all cast-in-place concrete including sides of footings. The Contractor shall construct and place forms to provide concrete of the shape, lines, dimensions and appearance indicated.

3.1.2 Removable panels shall be provided at the bottom of forms for walls and columns to allow cleaning, inspection, and joint surface preparation. Closable intermediate inspection ports shall be provided in forms for walls. The Contractor shall provide tremmies and hoppers for placing concrete and to allow concrete sampling, prevent segregation, and prevent the accumulation of hardened concrete on the forms and reinforcement above the fresh concrete.

3.1.3 Molding, bevels, or other types of chamfer strips shall be placed to produce blockouts, or chamfers as indicated on the approved drawings or as specified herein. Chamfer strips at horizontal and vertical projecting corners shall produce a ¾-inch chamfer. Rectangular moldings shall be provided at locations requiring sealants where shown on the approved drawings or specified herein.

3.1.4 The Contractor shall provide rigid forms to withstand construction loads and vibration and meeting specified deflection limits and tolerances. Forms shall be constructed so that the concrete will not be damaged by form removal. The Contractor shall be entirely responsible for the adequacy of the forming system.

3.2 FORM TOLERANCES

3.2.1 The Contractor shall design, construct, and surface forms in accordance with the recommendations of ACI 347R and meet the following additional requirements for the specified finishes.

3.2.2 Formed Surface Exposed to View: Edges of all form panels in contact with concrete shall be flush within 1/32 inch and forms for plane surfaces plane shall be within 1/16 inch in 4 feet. Maximum deviation of the finished surface at any point shall not exceed ¼ inch from the intended surface indicated. Arrange form panels symmetrically and orderly to minimize the number of seams. Tight forms shall be used to prevent the passage of mortar, water, and grout.

3.2.3 Formed Surface Not Exposed to View or Buried: Class "C" Surface per ACI 347R.

3.2.4 Formed Surface Including Mass Concrete, Pipe Encasement, Electrical Raceway Encasement, and Other Similar Installations: No minimum/maximum requirements for surface irregularities and surface alignment. The overall dimensions of the concrete shall be plus or minus 1 inch from the intended surface indicated.

3.3 FORM PREPARATION

3.3.1 The Contractor shall clean, repair, remove projecting nails and fill holes, and smooth protrusions on all form surfaces to be in contact with concrete before reuse. The Contractor shall not reuse forms for exposed concrete unless a "like new" condition of the form is maintained that will produce surfaces equivalent in smoothness and appearance to those produced by new plywood panels.

3.3.2 The Contractor shall coat wood forms in contact with concrete using form release agent prior to form installation.

3.3.3 Steel forms shall be cleaned by sand blasting or other method to remove mill scale and other ferrous deposits from the contact surface of all forms. Steel forms in contact with concrete shall be coated using form release agent prior to form installation.

3.4 REMOVAL OF FORMS

The Contractor shall be responsible for all damage resulting from removal of forms and make repairs at no additional cost to the Government. The Contractor shall leave in place forms and shoring for horizontal structural members in accordance with ACI 301 and ACI 347R. The Contractor shall conform to the requirements for form removal specified in SECTION 03300 - CAST-IN-PLACE CONCRETE.

3.5 INSPECTION

3.5.1 The Contractor shall notify the Engineer when the forms are complete and ready for inspection, at least 6 working hours prior to the proposed concrete placement.

3.5.2 Failure of the forms to comply with the requirements specified, or to produce concrete complying with requirements specified, shall be grounds for rejection of that portion of the concrete work. Repair or replace rejected work as directed by the Engineer at no additional cost to the Government. Such repair or replacement shall be subject to the requirements of these Specifications and approval of the Engineer.

END OF SECTION

SECTION 03150

CONCRETE JOINTS AND JOINT ACCESSORIES

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and incidentals required to install accessories for concrete joints as shown on the approved drawings and as specified herein.

1.2 REFERENCES

The publication listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the below standards, the revision in effect at the time of contract award shall apply.

<u>AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)</u>

ASTM A675	Standard Specification for Steel Bars, Carbon, Hot Wrought, Special Quality, Mechanical Properties
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

<u>U. S. ARMY CORPS OF ENGINEERS - CONCRETE RESEARCH DIVISION (USACE-CRD)</u>

CRD C572	Specification for Polyvinylchloride Waterstops

<u>AMERICAN WATER WORKS ASSOCIATION (AWWA)</u>

AWWA C653	Standard for Disinfection of Water Treatment Plants

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. All submittals shall be reviewed and approved by the structural engineer of record before submitting to the Engineer. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Product data; Product Data; EA

1.3.1.1 Waterstops: Product data including sample, catalogue cut, technical data, storage requirements, splicing methods, and conformity to CRD standards.

1.3.1.2 Premolded joint fillers: Product data including sample, catalogue cut, technical data, storage requirements, installation instructions, location of use, and conformity to ASTM standards.

1.3.1.3 Bond breaker: Product data including catalogue cut, technical data, storage requirements, application instructions, and location of use.

1.3.1.4 Expansion joint dowels: Product data on the complete assembly including dowels, coatings, expansion caps, installation instructions, and conformity to ASTM standards.

1.3.1.5 Sealant: Product data including catalogue cut, technical data, storage requirements, mixing and application instructions, location of use, and conformity to ASTM standards.

1.3.2 Certifications; Certificates; FIO

1.3.2.1 Certify that all materials used within the joint system are compatible with each other.

1.3.2.2 Certify that sealant is made for use in continuous immersion in contact with potable water (non-toxic and free of taste and odor).

1.4 QUALITY ASSURANCE

1.4.1 The Contractor shall provide the services of a manufacturer's field representative of the sealant who has performed at least five projects of similar size and complexity within the last 5 years. The field representative shall be present at the work site prior to any mixing of components to instruct on mixing, application, and inspection procedures and to inspect the finish of the prepared surfaces prior to application of the sealant.

1.4.2 The manufacturer's field representative shall make at least one additional visit to the site as the work progresses and shall report on each visit to the Contractor and the Engineer, advising as to whether the application is being performed in accordance with this Section and the manufacturer's printed instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Products shall be delivered in original, unopened containers displaying the manufacturer's label showing manufacturer name, product identification, and batch number.

1.5.2 Products shall be stored as recommended by the manufacturer.

PART 2 PRODUCTS

2.1 GENERAL

All materials used together in a given joint shall be compatible with one another. Selection of suppliers and products shall be coordinated to provide compatibility. Asphaltic bond breakers or joint fillers shall not be used in joints receiving sealant.

2.2 MATERIALS

2.2.1 Plastic Waterstops

2.2.1.1 Expansion joints in liquid retaining structures and other locations indicated. Nine (9)-inch by 3/8-inch ribbed type waterstops with a center bulb conforming to CRD C572 and made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1,750 psi. Waterstops shall be Style CR-9380 by Paul Murphy Plastics Co., Roseville, MI; Style 696 by

2.2.1.2 Non-expansion joints in liquid retaining structures and other locations indicated. Six (6)-inch by 3/8-inch ribbed type waterstops conforming to CRD C572 and made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1,750 psi.

2.2.2 Premolded Joint Filler

Self-expanding cork premolded joint filler conforming to ASTM D1752, Type III with 1-inch thickness unless otherwise indicated on the approved drawings.

2.2.3 Bond Breaker

2.2.3.1 Bond Breaker Tape: Adhesive-backed glazed butyl or polyethylene tape, which will adhere to the premolded joint filler or concrete surface. The Contractor shall provide tape the same width as the joint.

2.2.3.2 Bond breaker for concrete other than where tape is indicated on the approved drawings or specified: Either bond breaker tape or a nonstaining type bond prevention coating such as Williams Tilt-up Compound by Williams Distributors Inc.; Silcoseal 77, by Nox-crete Incorporated; Sure-Lift WB by Dayton Superior, or equal.

2.2.4 Expansion Joint Dowels

2.2.4.1 Smooth steel conforming to ASTM A675, Grade 70. Dowels shall be straight, clean, and free of loose flaky rust and loose scale. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04 inch on the diameter of the dowel and extends no more than 0.04 inch from the end. Bars shall be coated with a bond breaker on the expansion end of the dowel. Expansion caps shall be provided on the expansion end.

2.2.5 Sealant

2.2.5.1 Sealant for joints in horizontal surfaces shall conform to ASTM C920, Type S or M, Grade P or NS, Class 25. Sealant for joints in sloping and vertical surfaces shall conform to ASTM C920, Type S or M, Grade NS, Class 25. The Contractor shall provide Use T sealant in pedestrian and vehicular traffic areas and Use NT in non-traffic areas.

2.2.5.2 Sealants shall be made for use in continuous immersion in contact with potable water (non-toxic and free of taste and odor). Gray colored sealants shall be provided unless otherwise indicated on the approved drawings, specified, or approved by the Engineer.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Waterstops

3.1.1.1 The Contractor shall install waterstops for all joints where shown on the approved drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Splices by welding shall be made in accordance with the manufacturer's recommendations. The Contractor shall use only manufacturer's special approved tools for welding. The finished splices shall provide a cross-section that is dense and free of porosity. After splice has cooled, the Contractor shall spark test all splices in accordance with manufacturer's printed instructions. If splice shows any separation or lack of fusion reject the splice, the Contractor shall recut back at least 1 inch from rejected splice each side, reweld, and retest.

3.1.1.2 Waterstops shall be secured in wall joints before concrete is placed. If waterstop does not incorporate an integral fastening system, holes shall be drilled in waterstops 1 inch from each edge or between the outermost ribs at each edge. The waterstop in the joint shall be centered. The Contractor shall tie both edges of the waterstop to reinforcing steel with tie wire as specified for tying reinforcing steel. The Contractor shall secure the waterstop centered on and perpendicular to the joint and maintain this position during concrete placement.

3.1.1.3 Waterstop ties shall be spaced to match the spacing of the adjacent reinforcing, but not spaced closer than 12 inches on center.

3.1.1.4 Horizontal waterstops shall be clamped in slabs in position with the form bulkhead (unless previously set in concrete). Lift the edge of the waterstop while placing concrete below the waterstop. Manually force the waterstop against and into the placed concrete and cover with fresh concrete, to provide complete encasement of the waterstop in concrete.

3.1.1.5 A minimum number of splices in waterstops shall be provided.

3.1.1.6 Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Waterstops shall be completely embedded in void-free concrete.

3.1.1.7 Waterstops shall be terminated 2 inches below the exposed top of walls. Expansion joint waterstop center bulbs shall be plugged with foam rubber, 1 inch deep, at all points of termination.

3.1.2 Construction Joints

3.1.2.1 Construction joints shall be made only at locations shown on the approved drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor must be submitted to the Engineer for written approval. Construction joints shall not be eliminated.

3.1.2.2 Additional or relocated joints shall be located where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. However, if a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Joints shall be located in walls and columns at the underside of floors, slabs, beams or girders and at tops of footings or floor slabs. Joints shall not be located between beams, girders, column capitals, or drop panels and the slabs above them. Joints should not be located between brackets or haunches and walls or columns supporting them.

3.1.2.3 Unless indicated otherwise, joints shall be perpendicular to main reinforcement. Reinforcing steel shall be continued through the joint.

3.1.2.4 At all construction joints and at concrete joints indicated on the approved drawings to be "roughened," uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points and side to side) of ¼ inch with chipping tools to expose a fresh face. Joint surfaces shall be thoroughly cleaned of loose or weakened materials by waterblasting or sandblasting and shall be prepared for bonding. At least 2 hours before and again shortly before the new concrete is deposited, the joints shall be saturated with water. After glistening water disappears, joints shall be coated with neat cement slurry mixed to the consistency of very heavy paste. The surfaces shall receive a coating at least 1/8 inch thick, scrubbed-in by means of stiff bristle brushes. New concrete shall be deposited before the neat cement dries.

3.1.2.5 Waterstops shall be provided in wall and slab construction joints in liquid containment structures and at other locations shown on the approved drawings.

3.1.2.6 Keyways shall not be used in construction joints unless specifically shown on the approved drawings or approved by the Engineer.

3.1.3 Expansion Joints

3.1.3.1 Expansion joints shall be made at locations indicated on the approved drawings. Expansion joints shall not be eliminated.

3.1.3.2 Do not extend through expansion joints, reinforcement or other embedded metal items that are continuously bonded to concrete on each side of joint.

3.1.3.3 Premolded joint filler material shall be positioned parallel to finished surfaces. The joint filler shall be secured against displacement during concrete placement and compaction. Joint filler shall be placed over the face of the joint, allowing for sealant grooves as indicated. Tape all joint filler splices to prevent intrusion of mortar. Seal expansion joints as indicated on the approved drawings.

3.1.3.4 Expansion joints shall be 1 inch thick unless otherwise indicated on the approved drawings.

3.1.3.5 Where indicated on the approved drawings, smooth dowels shall be installed at right angles to expansion joints. Dowels shall be aligned with finished surface. Dowels shall be rigidly held in place and supported during concrete placement. Unless otherwise indicated on the approved drawings, a bond breaker shall be applied to one end of all dowels through expansion joints. Expansion caps shall be provided on the lubricated ends of expansion dowels.

3.1.3.6 Center bulb type waterstops, sealant grooves, and sealants shall be provided in wall and slab expansion joints in liquid containment structures and at other locations shown on the approved drawings.

3.1.4 Control Joints

3.1.4.1 Control joints shall be installed as shown on the approved drawings. Control joints shall not be eliminated.

3.1.4.2 Waterstops, sealant grooves, and sealants in wall and slab control joints shall be provided in liquid containment structures and at other locations shown on the approved drawings.

3.1.4.3 Every other bar of reinforcing steel shall be extended through control joints. The concrete surface shall be coated with a bond breaker prior to placing new concrete against it. Do not coat reinforcement or waterstops with bond breaker at these locations.

3.1.5 Sealant

3.1.5.1 Sealants shall be installed in clean dry recesses free of frost, oil, grease, form release agent, loose material, laitance, dust and other materials which will impair bond at the locations shown on the approved drawings. Sealant shall conform to all the manufacturer's recommendations including concrete cure, temperature, moisture, mixing, primer, primer cure time, joint and recess preparation, tooling, and curing. Masking tape shall be applied to each side of the joint prior to the installation of the sealant and remove afterwards along with any spillage to leave a sealant installation with straight edges.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment and incidentals required and install all concrete reinforcement complete as shown on the approved drawings and as specified herein, including dowels embedded into concrete for masonry.

1.2 REFERENCES

The publication listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the below standards, the revision in effect at the time of contract award shall apply.

<u>AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)</u>

ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A496	Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A497	Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

<u>AMERICAN CONCRETE INSTITUTE (ACI)</u>

ACI 301	Specifications for Structural Concrete for Buildings
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
SP-66 (ACI 315)	ACI Detailing Manual

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

Manual of Standard Practice

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4 Structural Welding Code - Reinforcing Steel

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. All submittals shall be reviewed and approved by the structural engineer of record before submitting to the Engineer. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Reinforcing Steel Shop Drawings; Shop Drawings; EA

Conform to the recommendations of ACI 315 for placement drawings. Include all reinforcement in a concrete placement on a single placement drawing or cross-referenced to the main pertinent placement drawing. Include the additional reinforcement around openings, at corners, and at other locations indicated. Identify bars to have special coatings and/or to be of special steel or special yield strength. The shop drawings shall include bar bending details. Reference bars to the same identification marks shown on the placement drawings. Identify bars to have special coatings and/or to be of special steel or special yield strength.

1.3.2 Mill Test Reports; Test Reports; EA

1.3.2.1 Certified copy of mill test on each heat of each steel proposed for use showing the physical properties of the steel and the chemical analysis.

1.3.3 Welder's Certification; Certificates; FIO

In accordance with AWS D1.4 when welding of reinforcement is indicated, specified, or approved.

1.4 DELIVERY, HANDLING, AND STORAGE

1.4.1 The Contractor shall provide reinforcing steel free from mill scale, rust, mud, dirt, grease, oil, ice, or other foreign matter.

1.4.2 Reinforcing steel shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted placement drawings. Tags for ASTM A706 reinforcing and for ASTM A615 reinforcing meeting the requirements of Paragraph 2.1.3 shall indicate that the reinforcing is weldable.

1.4.3 Reinforcing steel shall be stored off the ground, protected from moisture and kept free from rust, mud, dirt, grease, oil, ice, or other injurious contaminants.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 New materials of domestic manufacture complying with the following material specifications shall be provided.

2.1.2 Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.

2.1.3 Deformed Concrete Reinforcing Bars required on the approved drawings to be Field Bent or Welded: ASTM A706.

ASTM A615, Grade 60 may be substituted for ASTM A706 subject to the following:

- The actual yield strength of the reinforcing steel based on mill tests does not exceed the specified yield strength by more than 18,000 psi. Retests not to exceed this value by more than an additional 3,000 psi.

- The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement is not less than 1.25.

- The carbon equivalency (CE) is 0.55 percent or less.

2.1.4 Welded Steel Wire Fabric: ASTM A185.

2.1.5 Welded Deformed Steel Wire Fabric: ASTM A497.

2.1.6 Reinforcing Steel Accessories

2.1.6.1 Plastic Protected Wire Bar Supports: CRSI Bar Supports, Class 1 - Maximum Protection.

2.1.6.2 Stainless Steel Protected Wire Bar Supports: CRSI Bar Supports, Class 2 - Moderate Protection with legs made wholly from stainless steel wire.

2.1.6.3 Precast Concrete Bar Supports: CRSI Bar Supports, Precast Concrete Bar Supports. Precast concrete blocks that have equal or greater strength than the surrounding concrete.

2.1.7 Tie Wire

2.1.7.1 Tie Wires for Reinforcement: 16-gauge or heavier black annealed wire.

2.2 FABRICATION

2.2.1 The Contractor shall comply with the CRSI Manual of Standard Practice.

2.2.2 Bend bars cold. Do not straighten or rebend bars. Bars shall be bent around a revolving collar having a diameter not less than that recommended by the CRSI.

2.2.3 The Contractor shall saw cut bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded. Saw cut ends shall be terminated in flat surfaces within 1½ degrees of a right angle to the axis of the bar.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 The Contractor shall comply with the CRSI Manual of Standard Practice for surface condition, bending, spacing and tolerances of placement for reinforcement. The amount of reinforcing indicated at the spacings and clearances indicated on the approved drawings shall be provided.

3.1.2 Unless indicated otherwise on the approved drawings, the following minimum clear concrete cover over reinforcement shall be provided:

- Concrete cast against and permanently exposed to earth: 3 inches
- Concrete exposed to soil, water, sewage, sludge, and/or weather: 2 inches
- Concrete not exposed to soil, water, sewage, sludge, and/or weather:
- Slabs (top and bottom cover), walls, joists, shells, and folded plate members - 1 inch
- Beams and columns (principal reinforcement, ties, spirals and stirrups) - 1½ inches

3.1.3 The Contractor shall coat reinforcement that will be exposed for more than 60 days after placement with a heavy coat of neat cement slurry.

3.1.4 Reinforcing steel bars shall not be welded either during fabrication or erection unless indicated on the approved drawings or as specified herein, or unless prior written approval has been obtained from the Engineer. Remove immediately all bars that have been welded, including tack welds, without such approval. Comply with AWS D1.4 when welding of reinforcement is shown of the approved drawings, specified, or approved.

3.1.5 Reinforcing steel interfering with the location of other reinforcing steel, conduits or embedded items, may be moved within the specified tolerances or one bar diameter, whichever is greater. The Contractor shall obtain the approval of the Engineer if greater displacement of bars to avoid interference is needed. Reinforcement shall not be cut to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.

3.1.6 The Contractor shall secure, support and tie reinforcing steel to prevent movement during concrete placement. Dowels shall be secured in place before placing concrete.

3.1.7 The Contractor shall not field bend reinforcing unless indicated or specifically authorized in writing by the Engineer. Cold-bend bars indicated or authorized to be field bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. Replace, repair by cutting out damaged bars and splicing new bars using coupling sleeves filled with ferrous material, or otherwise repair damaged reinforcing bars as directed by the Engineer at no additional cost to the Government. Do not bend reinforcement after it is embedded in concrete unless indicated on the approved drawings.

3.2 REINFORCEMENT AROUND OPENINGS

Additional reinforcing steel on each side of the opening equivalent shall be provided to one half of the cross-sectional area of the reinforcing steel interrupted by the opening unless indicated otherwise on the approved drawings. The end of each bar shall be extended beyond the edge of the opening or penetration by the tension development length for that bar size.

3.3 SPLICING OF REINFORCEMENT

3.3.1 Splices shall be provided as shown on the approved drawings and as specified herein.

3.3.2 Splices Indicated as Compression Splices: Provide lap splice of 30 bar diameters, but not less than 12 inches unless indicated otherwise on the approved drawings. Base the lap splice length for column vertical bars on the bar size in the column above.

3.3.3 All Other Splices: Provide tension lap splices in compliance with ACI 318. Stagger splices in adjacent bars where possible. Provide Class B tension lap splices at all locations unless otherwise indicated.

3.3.4 Splices in Circumferential Reinforcement in Circular Walls: Provide Class B tension lap splices and stagger as indicated.

3.3.5 Tension Members: The Contractor shall avoid splicing of reinforcing steel in concrete elements indicated as "tension members." However, if splices are required for constructability, splices in the reinforcement subject to direct tension shall be butted and joined with complete penetration welds to develop, in tension, at least 125 percent of the specified yield strength of the bar. Offset splices in adjacent bars the distance of a Class B splice or 30 inches, whichever is greater.

3.3.6 Lap splices in welded wire fabric in accordance with the requirements of ACI 318 but not less than 12 inches. Tie the spliced fabrics together with wire ties spaced not more than 24 inches on center and lace with wire of the same diameter as the welded wire fabric. Offset splices in adjacent widths to prevent continuous splices.

3.4 ACCESSORIES

3.4.1 The Contractor shall determine, provide and install accessories such as chairs, chair bars and the like to support the reinforcement providing the spacings and clearances indicated on the approved drawings and prevent its displacement during the erection of the reinforcement and the placement of concrete.

3.4.2 Precast concrete blocks shall be used where the reinforcing steel is to be supported over soil.

3.4.3 Plastic protected bar supports or steel supports with plastic tips shall be used where the reinforcing steel is to be supported on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Stainless steel protected bar supports shall be used in walls, beams, and elevated slabs. Stainless steel supports or plastic tipped metal supports shall be used in all other locations unless otherwise noted on the approved drawings or specified herein.

3.4.4 The Contractor shall provide #5 minimum size support bars. Do not reposition upper bars in a bar mat for use as support bars.

3.4.5 Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.5 INSPECTION

The Contractor shall notify the Engineer when the reinforcing is complete and ready for inspection, at least 6 working hours prior to the proposed concrete placement. The Contractor shall not cover reinforcing steel with concrete until the installation of the reinforcement, including the size, spacing, and position of the reinforcement has been inspected by the Engineer and the Engineer's release to proceed with the concreting has been obtained. Forms shall be kept open until the Engineer has completed inspection of the reinforcing steel.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall furnish all labor, equipment, materials, and incidentals necessary to complete all concrete work as shown on the approved drawings and as specified herein.

1.2 REFERENCES

The publication listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the below standards, the revision in effect at the time of contract award shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete

ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C1017	Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete

AMERICAN CONCRETE INSTITUTE (ACI).

ACI 304R	Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI 305R	Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 318	Building Code Requirements for Structural Concrete
ACI 350R	Environmental Engineering Concrete Structures

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. All submittals shall be reviewed and approved by the structural engineer of record before submitting to the Engineer. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Mixture Proportions; Product Data; EA

The results of trial mix along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete, at least 14 calendar days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, attesting that the proportions selected will produce concrete of the qualities indicated on the Contract Drawings and specified herein. No substitutions shall be made in the materials used in the work without additional tests to show that the quality of the concrete is satisfactory. Mix designs shall be reviewed and approved by the structural engineer of record and the Engineer.

1.3.2 Testing and Inspection for Contractor Quality Control; Test Reports; FIO

The contractor shall submit certified copies of laboratory test reports, including all test data for portland cement, pozzolan, aggregate, admixtures, and curing compound. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials.

1.3.3 Qualifications, Manufacturer's Certification; Certificates; FIO

The contractor shall provide written documentation that the Contractor Quality Control personnel assigned to concrete construction shall be ACI certified workmen or shall have written evidence of having completed similar qualifications program.

1.4 QUALITY ASSURANCE

1.4.1 Reinforced concrete shall comply with ACI 318, the recommendations of ACI 350R and other stated requirements, codes and standards. The most stringent requirement of the codes, standards and this Section shall apply when conflicts exist.

1.4.2 Only one source of cement and aggregates shall be used on any one structure. Concrete shall be uniform in color and appearance.

1.4.3 Well in advance of placing concrete, the Contractor shall discuss with the Engineer the sources of individual materials and batched concrete proposed for use. The Contractor shall discuss placement methods, waterstops and curing and propose methods of hot and cold weather concreting as required.

1.4.4 If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the Contractor's expense.

1.4.5 If, during the progress of the work, the materials from the sources originally accepted change in characteristics, the Contractor shall, at his/her expense, make new acceptance tests of aggregates and establish new design mixes.

1.4.6 Testing of the following materials shall be furnished by Contractor to verify conformity with this Specification Section and the stated ASTM Standards.

1.4.6.1 Fine aggregates for conformity with ASTM C33 - sieve analysis, physical properties, and deleterious substances.

1.4.6.2 Coarse aggregates for conformity with ASTM C33 - sieve analysis, physical properties, and deleterious substances.

1.4.6.3 Cements for conformity with ASTM C150 - chemical analysis and physical properties.

1.4.6.4 Proposed concrete mix designs - compressive strength, slump, and air content.

1.4.6.5 Field testing and inspection services will be provided by the Contractor and approved by the structural engineer of record. Testing shall be performed by the Contractor to verify conformity with this Specification Section for concrete compressive strength (cylinders), compressive strength (cores), slump, and air content, and all other materials or products that may come under question.

1.4.7 All materials incorporated in the work shall conform to accepted samples.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Cement shall be stored in weathertight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set.

1.5.2 Aggregate shall be arrange and used in stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Stockpiles shall be built in successive horizontal layers not exceeding 3 feet in thickness. Each layer shall be completed before the next is started. Frozen or partially frozen aggregate shall not be used.

1.5.3 Sand shall be arranged and used in stockpiles to avoid contamination. Sand shall be allowed to drain to a uniform moisture content before using. Frozen or partially frozen sand shall not be used.

1.5.4 Admixtures shall be stored in closed containers to avoid contamination, evaporation or damage. Suitable agitating equipment shall be provided to assure uniform dispersion of ingredients in admixture solutions that tend to separate. Liquid admixtures shall be protected from freezing and other temperature changes that could adversely affect their characteristics.

1.5.5 Sheet Curing Materials shall be stored in weathertight buildings or off the ground and under cover.

1.5.6 Liquid Curing Compounds shall be stored in closed containers.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

2.1.2 Like items of materials shall be the end products of one manufacturer to provide standardization for appearance, maintenance and manufacturer's service.

2.2 MATERIALS

Materials shall comply with this Section and any applicable State or local requirements.

2.2.1 Cement: Domestic Portland cement complying with ASTM C150. Air entraining cements shall not be used. Cement brand shall be subject to approval by the Engineer and one brand shall be used throughout the Work. Cement shall be Type II.

2.2.2 Fine Aggregate: Washed inert natural sand conforming to the requirements of ASTM C33.

2.2.3 Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33. Grading requirements shall be as listed in ASTM C33 Table 2 for the specified coarse aggregate size number. Limits of Deleterious Substances and Physical Property Requirements shall be as listed in ASTM C33 Table 3 for severe weathering regions. Size numbers for the concrete mixes shall be as shown in Table 03300-1 herein.

2.2.4 Water: Potable water free from injurious amounts of oils, acids, alkalis, salts, organic matter, or other deleterious substances.

2.2.5 Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix including other admixtures.

2.2.5.1 Air-Entraining Admixture: The admixture shall comply with ASTM C260. Proportioning and mixing shall be in accordance with manufacturer's recommendations.

2.2.5.2 Water-Reducing Agent: The admixture shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with manufacturer's recommendations.

2.2.5.3 High-Range Water-Reducer (Plasticizer): The admixture shall comply with ASTM C494, Type F or ASTM C1017, Type I and shall result in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cement ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours. Proportioning and mixing shall be in accordance with manufacturer's recommendations.

2.2.5.4 Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer. When allowed, the admixtures shall be retarding or accelerating water reducing or high range water reducing admixtures.

2.2.5.5 Sheet Curing Materials. Waterproof paper, polyethylene film or white burlap-polyethylene sheeting all complying with ASTM C171.

2.3 MIXES

2.3.1 Development of mix designs and testing shall be by an independent testing laboratory acceptable to the Engineer engaged by and at the expense of the Contractor.

2.3.2 Proportions of ingredients shall be selected to meet the design strength and a material limits specified in Table 03300-1 and to produce concrete having proper placability, durability, strength, appearance and other required properties. Ingredients shall be proportioned to produce a homogenous mixture that will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.

2.3.3 The design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data is not available, be developed by a testing laboratory, acceptable to the Engineer, engaged by and at the expense of the Contractor. Acceptance of mixes based on standard deviation shall be based on the modification factors for standard deviation tests contained in ACI 318. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between water cementitious ratio and 7- and 28-day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to yield the desired data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16 percent greater than the specified design strengths. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 03300-1.

Table 03300-1
Concrete Mix Requirements

Design Class	Strength (1)	Fine Cement (2)	Coarse Aggregate (3)	Cementitious Aggregate (4)	Content
A	3000	C150 Type II	C33	57	440 min.
B	4000	C150 Type II	C33	57	560 min.

Class	W/C Ratio (5)	Fly Ash	AE Range (6)	WR (7)	HRWR (8)	Slump Range Inches
A	0.62 max.	15-25%	3.5 to 5	Yes	No	1-4
B	0.44 max.	15-25%	3.5 to 5	Yes	No	3-5

Notes:
(1) Minimum compressive strength in psi at 28 days
(2) ASTM designation
(3) Size Number in ASTM C33
(4) Cementitious content in lb/cu yd
(5) W/C is Water-Cementitious ratio by weight
(6) AE is percent air-entrainment
(7) WR is water-reducer admixture
(8) HRWR is high-range water-reducer admixture

2.3.4 Compression Tests: The Contractor shall provide testing of the proposed concrete mix or mixes to demonstrate compliance with the specified design strength requirements in conformity with the above paragraph.

2.3.5 Entrained air, as measured by ASTM C231, shall be as shown in Table 03300-1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal.

2.3.6 Slump of the concrete as measured by ASTM C143, shall be as shown in Table 03300-1. If a high-range water-reducer (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10 inches.

2.3.7 Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

PART 3 EXECUTION

3.1 MEASURING MATERIALS

3.1.1 Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, water and admixtures as specified and shall be produced by a plant acceptable to the Engineer. All constituents, including admixtures, shall be batched at the plant except a high-range water-reducer may also be added in the field.

3.1.2 Materials for batching concrete shall be measured by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Scales shall have been certified by the local Sealer of Weights and Measures within 1 year of use.

3.1.3 The amount of free water in fine aggregates shall be measured within 0.3 percent with a moisture meter. The Contractor shall compensate for varying moisture contents of fine aggregates. The number of gallons of water as-batched on printed batching tickets shall be recorded.

3.1.4 Admixtures shall be dispensed either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture. The Contractor shall charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device. Multiple admixtures shall be injected separately during the batching sequence.

3.2 MIXING AND TRANSPORTING

3.2.1 Concrete shall be ready-mixed concrete produced by equipment acceptable to the Engineer. No hand-mixing shall be permitted. Each transit mix truck drum shall be cleaned and the drum rotation shall be reversed before the truck proceeds under the batching plant. Each transit-mix truck shall be equipped with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.

3.2.2 Ready-mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.

3.2.3 The water tank valve on each transit trucks shall be locked at all times. Any addition of water must be directed by the Engineer. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.

3.2.4 All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94.

3.2.5 The Contractor shall select equipment of size and design to ensure continuous flow of concrete at the delivery end. Metal or metal-lined non-aluminum discharge chutes shall be used and shall have slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.

3.2.6 Retempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar that has reached initial set will not be permitted.

3.2.7 The Contractor shall handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Trucks shall be dispatched from the batching plant so they arrive at the work site just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.

3.2.8 The Contractor shall furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. The Contractor shall use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. The ticket shall clearly indicate the weight of fine and coarse aggregate, cement and water in each batch, the quantity delivered, the time any water is added, the numerical sequence of the delivery, the time of day batched, the time of discharge from the truck, and the number of revolutions of the truck mixer.

3.2.9 Temperature and Mixing Time Control

3.2.9.1 In cold weather, the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms shall not drop below 40 degrees F.

3.2.9.2 If water or aggregate has been heated, the Contractor shall combine water with aggregate in the mixer before cement is added. Cement shall not be added to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.

3.2.9.3 In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. If necessary, substitute well-crushed ice for all or part of the mixing water.

3.2.9.4 The maximum time interval between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms shall not exceed the values shown in Table 03300-2.

Table 03300-2
Maximum Time to Discharge of Concrete

Air or Concrete Temperature (whichever is higher)	Maximum Time
80 to 90 Degrees F (27 to 32 Degrees C)	45 minutes
70 to 79 Degrees F (21 to 26 Degrees C)	60 minutes
40 to 69 Degrees F (5 to 20 Degrees C)	90 minutes

If an approved high-range water-reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

3.3 CONCRETE APPEARANCE

3.3.1 Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed. If this does not correct the condition, the concrete shall be rejected. If the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed, changes in the concrete mix shall be obtained only by adjusting one or more of the following:

- The gradation of aggregate.
- The proportion of fine and coarse aggregate.
- The percentage of entrained air, within the allowable limits.

3.3.2 Concrete for the work shall provide a homogeneous structure which, when hardened, will have the required strength, durability and appearance. Mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete, when viewed in good lighting from 10 feet away, shall be pleasing in appearance, and at 20 feet shall show no visible defects.

3.4 PLACING AND COMPACTING

3.4.1 Placing

3.4.1.1 The Contractor shall verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Ice, excess water, dirt and other foreign materials shall be removed from forms. The Contractor shall confirm that reinforcement and other embedded items are securely in place. A competent workman who can assure that reinforcing steel and embedded items remain in designated locations shall be at the location of the placement while concrete is being placed. Semi-porous subgrades or forms shall be sprinkled to eliminate suction of water from the mix. Extremely porous subgrades shall be sealed in an approved manner.

3.4.1.2 Concrete shall be deposited as near its final position as possible to avoid segregation due to rehandling or flowing. Concrete shall be placed continuously at a rate that ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete that has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.

3.4.1.3 Pumping of concrete will be permitted. The Contractor shall use a mix design and aggregate sizes suitable for pumping and submit to the Engineer for approval.

3.4.1.4 Temporary spreaders shall be removed from the forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.

3.4.1.5 Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs and/or walls) has reached adequate strength.

3.4.1.6 Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of the mortar against the form. Prevent the formation of excessive surface voids.

3.4.1.7 Slabs

3.4.1.7.1 After suitable bulkheads, screeds and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.

3.4.1.7.2 Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.

3.4.1.7.3 Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow 1 hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist so as to prevent cold joints.

3.4.1.8 Concrete shall be placed in forms using tremmie tubes, taking care to prevent segregation. Bottom of tremmie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4 feet. Place concrete for walls in 12- to 24-inch lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 7 feet and the maximum free fall of concrete shall not exceed 15 feet.

3.4.2 Compacting

3.4.2.1 Concrete shall be consolidated by vibration, puddling, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, embedded items and openings and into corners of forms. Puddling, spading, etc., shall be continuously performed along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.

3.4.2.2 All concrete shall be placed and compacted with mechanical vibrators. The number, type and size of the units shall be approved by the Engineer in advance of placing operations. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.

3.4.2.3 A minimum frequency of 7,000 rpm shall be required for mechanical vibrators. Insert vibrators and withdraw at points from 18 to 30 inches apart. At each insertion, vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.

3.4.2.4 Concrete Slabs: Concrete for slabs less than 8 inches thick shall be consolidated with vibrating screeds; slabs 8 to 12 inches thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.

3.4.2.5 Walls and Columns: Internal vibrators (rather than form vibrators) shall be used unless otherwise approved by the Engineer. In general, for each vibrator needed to melt down the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize and perfect the surface. The vibrators shall be inserted vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.

3.4.2.6 Vibrators shall be used to consolidate properly placed concrete but shall not be used to move or transport concrete in the forms. Vibration shall continue until:

- Frequency returns to normal.
- Surface appears liquefied, flattened and glistening.
- Trapped air ceases to rise.
- Coarse aggregate has blended into surface, but has not disappeared.

3.5 CURING AND PROTECTION

3.5.1 The Contractor shall protect all concrete work against injury from the elements and defacements of any nature during construction operations.

3.5.2 Curing Methods

3.5.2.1 Curing Methods for Concrete Surfaces: Concrete shall be cured to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing. Curing methods to be used are as follows:

3.5.2.1.1 Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling or covered with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.

3.5.2.1.2 Sheet Material Curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.

3.5.2.1.3 Liquid Membrane Curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional concrete is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Curing compound shall be applied as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Application shall be in compliance with the manufacturer's recommendations.

3.5.2.2 Specified applications of curing methods:

3.5.2.2.1 Slabs for Water Containment Structures: Water curing only.

3.5.2.2.2 Slabs on Grade and Footings (not used to contain water): Water curing, sheet material curing or liquid membrane curing.

3.5.2.2.3 Structural Slabs (other than water containment): Water curing or liquid membrane curing.

3.5.2.2.4 Horizontal Surfaces that will receive additional concrete, coatings, grout or other material that requires bond to the substrate: Water curing.

3.5.2.2.5 Formed Surfaces: None if nonabsorbent forms are left in place 7 days. Water cure if absorbent forms are used. Sheet cured or liquid membrane cured if forms are removed prior to 7 days. Exposed horizontal surfaces of formed walls or columns shall be water cured for 7 days or until next placement of concrete is made.

3.5.2.2.6 Concrete Joints: Water cured or sheet material cured.

3.5.2.3 Cold Weather Concreting:

3.5.2.3.1 "Cold weather" is defined as a period when for more than 3 successive days, the average daily outdoor temperature drops below 40 degrees F. The average daily temperature shall be calculated as the average of the highest and the lowest temperature during the period from midnight to midnight.

3.5.2.3.2 Cold weather concreting shall conform to ACI 306.1 and the additional requirements specified herein. Temperatures at the concrete placement shall be recorded at 12-hour intervals (minimum).

3.5.2.3.3 The Contractor shall discuss a cold weather work plan with the Engineer. The discussion shall encompass the methods and procedures proposed for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the Engineer.

3.5.2.3.4 During periods of cold weather, concrete shall be protected to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree-days of curing. Degree-days are defined as the total number of 24-hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (e.g., 5 days at an average 70 degrees F). To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.

3.5.2.3.5 Salt, manure or other chemicals shall not be used for protection.

3.5.2.3.6 The protection period for concrete being water cured shall not be terminated during cold weather until at least 24 hours after water curing has been terminated.

3.5.2.4 Hot Weather Concreting

3.5.2.4.1 "Hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation estimated in accordance with ACI 305R, approaching or exceeding 0.2 $lb/ft^2/hr$).

3.5.2.4.2 Concrete placed during hot weather, shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R and the additional requirements specified herein.

3.5.2.4.3 Temperature of concrete being placed shall not exceed 90 degrees F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints.

3.5.2.4.4 All necessary precautions shall be taken to promptly deliver, to promptly place the concrete upon its arrival at the job and to provide vibration immediately after placement.

3.5.2.4.5 The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.

3.5.2.4.6 Discuss with the Engineer a work plan describing the methods and procedures proposed to use for concrete placement and curing during hot weather periods. Hot weather concreting shall not begin until the work plan is acceptable to the Engineer.

3.6 REMOVAL OF FORMS

3.6.1 Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 30 percent of its specified design strength, nor before reaching the number of day-degrees of curing detailed in Table 03300-3 (whichever is the longer):

Table 03300-3
Minimum Time to Form Removal

Forms for	Degree Days
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree-days in Paragraph 3.5.2.3.4 above).

3.6.2 Shores shall not be removed until the concrete has attained at least 60 percent of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.

3.7 INSPECTION AND FIELD TESTING

3.7.1 The batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection of the Engineer at all times. The Contractor shall advise the Engineer of his/her readiness to proceed at least 24 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing steel and the alignment, cleanliness and tightness of formwork. No placement shall be made without the inspection and acceptance of the Engineer.

3.7.2 Sets of field control cylinder specimens will be taken by the Engineer (or inspector) during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 150 yd^3 of concrete nor less than one set for each 5,000 ft^2 of surface area for slabs or walls.

3.7.2.1 A "set" of test cylinders consists of four cylinders: one to be tested at 7 days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 35 days or to verify strength after 28 days if 28-day test results are low.

3.7.2.2 When the average 28-day compressive strength of the cylinders in any set falls below the specified design strength or below proportional minimum 7-day strengths (where proper relation between seven and 28-day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.

3.7.3 Cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through the operations and furnish material and labor required for the purpose of taking concrete cylinder samples. Curing boxes shall be acceptable to the Engineer.

3.7.4 Slump tests will be made in the field immediately prior to placing the concrete. Such tests shall be made in accordance with ASTM C143. If the slump is greater the specified range, the concrete shall be rejected.

3.7.5 Air Content: Test for air content shall be made on fresh concrete samples. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If lightweight aggregates or aggregates with high absorptions are used, the latter test method shall be used.

3.7.6 The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.

3.7.7 Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. Repair all core holes.

3.8 FAILURE TO MEET REQUIREMENTS

3.8.1 Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 03300-1, the Engineer shall have the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements the Contractor and Engineer shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is the Contractor in this Section.

3.8.2 When the tests on control specimens of concrete fall below the specified strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In the case of cores not indicating adequate strength, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Tests need not be made until concrete has aged 60 days.

3.8.3 Should the strength of test cylinders fall below 60 percent of the required minimum 28-day strength, the concrete shall be rejected and shall be removed and replaced.

3.9 PATCHING AND REPAIRS

3.9.1 It is the intent of this Section to require quality work including adequate forming, proper mixture and placement of concrete and curing so completed concrete surfaces will require no patching.

3.9.2 Defective concrete and honeycombed areas as determined by the Engineer shall be repaired as required by the Engineer.

3.9.3 As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed; recesses left by the removal of form ties shall be filled; and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.

3.9.4 Immediately after removal of forms remove plugs and break off metal ties as required by SECTION 03100 - CONCRETE FORMWORK. Promptly fill holes upon stripping as follows: Moisten the hole with water, followed by a 1/16-inch brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spider web. Trowel smooth with heavy pressure. Avoid burnishing.

3.9.5 When patching exposed surfaces the same source of cement and sand as used in the parent concrete shall be employed. Adjust color if necessary by addition of proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

3.10 SCHEDULE

Table 03300-4 represents the general applications for the various concrete classes and design strengths:

Table 03300-4
Concrete Schedule

Class	Design Strength (psi)	Description
A	3,000	Concrete fill and duct encasement
B	4,000	Walls, slabs on grade, suspended slab and beam systems, columns, grade beams, vaults and all other structural concrete

END OF SECTION

SECTION 03410

PRECAST CONCRETE STRUCTURES

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall furnish all labor, materials and equipment required to install precast concrete vaults, handholes, junction boxes, pull boxes, frames and covers, access hatches, and appurtenances as shown on the Contract Drawings and as specified herein.

1.2 REFERENCES

The publication listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the above standards, the revision in effect at the time of contract award shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A48	Standard Specification for Gray Iron Castings
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C150	Standard Specification for Portland Cement
ASTM C207	Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM D4101	Standard Specification for Polypropylene Plastic Injection and Extrusion Materials

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	Building Code Requirements for Structural Concrete
ACI 350R	Code Requirements for Environmental Engineering Concrete Structures

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

Standard Specifications for Highway Bridges

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. All submittals shall be reviewed and approved by the structural engineer of record before submitting to the Engineer. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Shop Drawings; Shop Drawings; EA

Submit shop drawings, product data, materials of construction, and details of installation. Submittals shall include the following:

1.3.1.1 Detailed drawings of base and riser sections, showing pipe connection to structure

1.3.1.2 Method of repair for minor damage to precast concrete sections

1.3.2 Design Data; Test Reports; EA

1.3.2.1 Sectional plan(s) and elevations showing dimensions and reinforcing steel placement

1.3.2.2 Structural calculations including assumptions by delegate engineer. Memo from structural engineer of record indicating approval or "No exceptions taken" to the calculations and design of the precast structures.

1.3.2.3 Concrete design mix

1.3.3 Test Reports; Test Reports; EA

Concrete test cylinder reports from an approved testing laboratory, for all precast concrete structures, certifying conformance with this Specification.

1.3.4 Material Certificates; Certificates; FIO

Certified copies of test reports demonstrating conformance to applicable precast concrete structure specifications, before materials are installed.

1.3.5 Compliance Certificates; Certificates; FIO

Notarized certificate indicating compliance with ASTM C478.

1.4 QUALITY ASSURANCE

1.4.1 All material shall be new and unused. Material quality, manufacturing process, and finished sections are subject to inspection and approval by the Engineer and structural engineer of record. Inspection may be made at place of manufacture, at the work site following delivery, or both. Materials will be examined for compliance with ASTM standards, this specification and approved manufacturer's drawings. Additional inspection criteria shall include appearance, dimensions, blisters, cracks and soundness.

1.4.2 Materials shall be rejected for failure to meet any requirements specified herein. Rejection may occur at place of manufacture, at the work site, or following installation. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost.

1.4.3 The Contractor shall repair minor damage to precast concrete sections by approved method, if repair is authorized by the Engineer.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

2.1.2 Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service.

2.1.3 Provide lifting lugs or holes in each precast section for proper handling.

2.2 PRECAST CONCRETE STRUCTURE SECTIONS

Precast concrete base sections, riser sections, transition top sections, and grade rings shall conform to ASTM C478 and meet the following requirements:

2.2.1 Bottom slab thickness shall equal or exceed the riser wall thickness.

2.2.2 Base, riser and transition top sections shall have tongue and groove joints.

2.2.3 Sections shall be cured by an approved method.

2.2.4 Precast concrete sections shall be shipped after concrete has attained 3,000 psi compressive strength.

2.2.5 Design precast concrete base and riser, for a minimum H-20 loading plus earth load. Calculate earth load with a unit weight of 130 pounds per cubic foot (pcf) (min).

2.2.6 Mark date of manufacture, name and trademark of manufacturer on the inside of each precast section.

2.2.7 The Contractor shall construct and install precast concrete base as shown on the approved drawings.

2.2.8 The Contractor shall provide integrally cast knock-out panels in precast concrete structure sections at locations, and with sizes shown on approved drawings. Knock-out panels shall have no steel reinforcing.

2.3 PRECAST CONCRETE STRUCTURES

2.3.1 Refer to drawings for inside dimensions, headroom requirements and minimum thickness of concrete.

2.3.2 Manufacturer shall notify the Engineer at least 5 working days prior to placing concrete during manufacturing process. The Engineer may inspect reinforcing steel placement prior to placing concrete.

2.3.3 Structural design calculations and drawings shall be prepared and stamped by the delegate engineer, who is a professional engineer registered in the State of New York. Structural design calculation and drawings shall be approved by the structural engineer of record and the Engineer. Approval by the Engineer and structural engineer of record of these items shall not relieve the Contractor of the responsibility from carrying out the work in full compliance with the requirements of the Contract Drawings and specifications.

2.3.4 Design Criteria

2.3.4.1 Precast concrete

2.3.4.1.1 Minimum compressive strength shall be 5,000 psi at 28 days.

2.3.4.1.2 Maximum water-to-cement ratio shall be 0.40 by weight.

2.3.4.1.3 Minimum cement content shall be 600 lbs of cement per cubic yard of concrete.

2.3.4.2 Manufactured products

2.3.4.2.1 Conform to ACI 318 and ACI 350R.

2.3.4.2.2 Analyze walls and slabs using accepted engineering principals.

2.3.4.2.3 When "fy" exceeds 40,000 psi, "z" (ACI 318) shall not exceed 95 kips/in, "fs" shall be completed and shall not exceed 50 percent of "fy."

2.3.4.2.4 Products shall be designed to support their own weight, weight of soil, and a live load equal to AASHTO HS-20 applied to the structure.

2.3.4.2.5 Base slab and walls shall be cast together to form a monolithic base section.

2.3.4.2.6 The Contractor shall design structure walls for a lateral pressure based on an equivalent fluid unit weight of 90 pcf. Originate pressure diagram at finished ground surface. Include lateral pressure from vehicles in accordance with AASHTO.

2.3.4.2.7 The Contractor shall consider discontinuities in structure produced by openings and joints and provide additional reinforcing around openings. Frame openings to carry full design loads to support walls.

2.3.4.2.8 Prevent flotation, with ground water level at finished ground surface, by dead weight of structure and soil load above structure. Do not consider skin friction, soil friction, or weight of equipment in structure.

2.3.4.2.9 The horizontal wall joints shall be located a minimum of 18 inches from horizontal centerline of wall openings.

2.3.4.2.10 The structure shall be designed with a minimum number of joints.

2.3.4.2.11 Lifting hooks shall be provided for each structure.

2.3.4.2.12 Access openings, wall sleeves, and pipe penetrations shall be located as shown on Contract Drawings.

2.3.4.2.13 The precast concrete manufacturer shall provide wall sleeves.

2.4 PIPE CONNECTIONS TO STRUCTURE

The Contractor shall connect pipe to the precast concrete structure in one of the following ways:

2.4.1 Grout in place - Precast concrete structure section shall have a formed, tapered circular opening larger than the pipe outside diameter. Grout shall be non-shrink and waterproof equal to Hallemite, Waterplug, or Embeco. Plastic pipe shall have a waterstop gasket secured to pipe with a stainless steel clamp.

2.4.2 Flexible sleeve - Integrally cast sleeve in precast concrete structure section or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PSX Press-Seal Gasket or equal.

2.4.3 Compression gasket - Integrally cast compression gasket in precast concrete structure section. Insert pipe into compression gasket. Compression gasket shall be A-Lok or equal.

2.5 DAMPPROOFING

Dampproofing shall be Hydrocide 648 by Sonneborn Building Products; Dehydratine 4 by A.C. Horn Inc; Meadows Trowel Mastic (Type 3) or equal.

2.6 ACCESS HATCHES

2.6.1 Access hatches shall not be allowed in precast concrete structures located in paved areas. Access hatches shall have single or double leaf doors. The doors shall be ¼-inch aluminum diamond pattern plate with welded stiffeners, as necessary, to withstand an AASHTO H20 wheel load. Hatches shall have a ¼-inch aluminum channel frame with a perimeter anchor flange or strap anchors for concrete embedment around the perimeter.

2.6.2 Covers shall be equipped with heavy-forged brass hinges that utilize stainless steel pins and shall pivot such that the cover does not protrude into the channel frame. Hinges shall be through-bolted to the cover with tamper-proof stainless steel lock bolts and shall be through-bolted to the frame with stainless steel bolts and lock nuts. Covers shall be equipped with compression springs and enclosed in telescopic tubes. Upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the tube assembly. Lower tube shall interlock with a flanged support shoe fastened to a formed ¼-inch gusset support plate.

2.6.3 Covers shall be fitted with the required number of compression spring operators to afford ease of opening through the entire arc of opening and to act as a check in retarding downward motion when being closed. Covers shall be equipped with a hold-open arm, which automatically locks the cover in the open position. A conveniently located handle shall release the covers for closing.

2.6.4 A stainless steel snap lock with fixed turn handle shall be mounted on the underside of the cover. A removable exterior lock handle shall be provided, and the latch release shall be protected by a flush-gasketed, removable, screw plug. Covers shall have a lift handle that is designed to be flush with the walking surface when not in use. Hatches shall be watertight and have a 1½-inch drainage coupling to the channel frame. Hardware shall be durable and corrosion resistant with Type 316 stainless steel hardware used throughout.

2.6.5 Finish shall be the factory mill finish for aluminum doors and frames with bituminous coating on the exterior of the frames in contact with concrete. Installation shall be in accordance with the manufacturer's instructions, and the manufacturer shall guarantee satisfactory operation. Manufacturer shall guarantee against defects in material and workmanship for a period of 5 years.

2.7 FRAMES AND GRATES OR FRAMES AND COVERS

2.7.1 Frames, grates and/or cover shall be used in precast concrete structures in paved areas including parking lots. Casting shall be of good quality, strong, tough, even-grained, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Castings shall be thoroughly cleaned and will be subjected to a hammer inspection in the field by the Engineer. All matching surfaces shall be machined to a true plane surface to allow contact surfaces to seat at all points without rocking.

2.7.2 Frames, covers, and cast grates for structures shall be gray iron castings except as otherwise specified.

2.7.3 Electrical and telephone manhole and handhole frames and covers for structures shall be ductile iron castings. The covers shall be watertight. The clear opening shall be 36 inches unless otherwise indicated.

2.8 JOINTING PRECAST STRUCTURE SECTIONS

2.8.1 Tongue and groove joints of precast structure sections shall be sealed with either a round rubber O-ring gasket or a preformed flexible joint sealant. The O-ring shall conform to ASTM C443.

2.8.2 Joints shall be designed and manufactured so that the completed joint will withstand an internal water pressure of 15 psi without leakage or displacement of the gasket or sealant.

2.9 MANHOLE RUNGS

Manhole rungs shall be either of the following types:

2.9.1 Cast aluminum alloy 6061-T6, drop front design, 12 inches wide with an abrasive step surface conforming to OSHA requirements.

2.9.2 Steel reinforced, copolymer polypropylene, 14 inches wide, M.A. Industries Inc, PF Series, or equal. Copolymer propylene shall conform to ASTM D4101 Classification PP0344 B33534Z02. Steel reinforcing shall be conforming to ASTM A615, Grade 60 and shall be continuous throughout the rung.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Precast Concrete Structure Installation.

3.1.1.1 The precast concrete structure shall be constructed to the dimensions shown on the Drawings and as specified herein. Protect all work against flooding and flotation.

3.1.1.2 The structure base shall be placed on a bed of 12 inches of crushed stone. Set structure base grade so that a maximum grade adjustment of 8 inches is required to bring the frame and cover to final grade.

3.1.1.3 Use precast concrete grade rings or brick and non-shrink mortar to adjust the structure frame and cover to final grade.

3.1.1.4 Set precast structures plumb with a ¼ inch maximum out-of-plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber O-ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finished flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with lead wool or non-shrink grout to the satisfaction of the Engineer.

3.1.1.5 Allow joints to set for 14 hours before backfilling unless a shorter period is specifically approved by the Engineer.

3.1.1.6 Plug holes in the concrete barrel sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.

3.1.1.7 Cut holes in precast sections to accommodate pipes prior to setting precast concrete structure sections in place to prevent jarring that may loosen the mortar joints.

3.1.1.8 Backfill carefully and evenly around precast concrete structures.

3.1.2 Pipe Connections

Construct precast concrete structure pipe connections, including pipe stubs, as specified above. Close or seal pipe stubs for future connections with a gasketed watertight plug.

3.1.3 Setting Access Hatch(es), Frame and Cover

Set Covers and frames in a full mortar bed. Utilize bricks or precast concrete grade rings, a maximum of 8 inches thick, to assure frame and cover are set to the finished grade. Set frame and cover to final grade prior to placement of permanent paving.

3.1.4 Dampproofing

Paint outer surfaces of precast and cast-in-place concrete structures with two coats of bituminous dampproofing at the rate of 30 to 60 ft^2 per gallon, in accordance with manufacturer's instructions. Only structures or parts of structure below grade shall be dampproofed.

3.1.5 Manhole Rings Installaion

Manhole rings shall be installed to allow access to equipment and facilities within the concrete pre-cast structures.

3.2 LEAKAGE TESTS

Test each concrete structure for leakage. The Engineer shall observe each test. Perform exfiltration test as described below:

3.2.1 Assemble concrete structure in place; fill and point all lifting holes and exterior joints within 6 feet of the ground surface with an approved non-shrinking mortar. Test prior to placing the shelf and invert and before filling and pointing the horizontal joints below 6 feet of depth. Lower ground water table below bottom of the concrete structure for the duration of the test. Plug all pipes and other openings into the concrete structure and brace to prevent blow out.

3.2.2 Fill concrete structure with water to the top. If the excavation has not been backfilled and no water is observed moving down the surface of the concrete structure, the concrete structure is satisfactorily water-tight. If the test, as described above is unsatisfactory as determined by the Engineer, or if the concrete structure excavation has been backfilled, continue the test. A period of time may be permitted to allow for absorption. Following this period, refill concrete structure to the top, if necessary and allow at least 8 hours to pass. At the end of the test period, refill the concrete structure to the top again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. The leakage for each concrete structure shall not exceed one gallon per vertical foot for a 24-hour period. If the concrete structure fails this requirement, but the leakage does not exceed three gallons per vertical foot per day, repairs by approved methods may be made as directed by the Engineer. If leakage due to a defective section of joint exceeds three gallons per vertical foot per day, the concrete structure shall be rejected. Uncover the rejected concrete structure as necessary and to disassemble, reconstruct or replace it as directed by the Engineer. Retest the concrete structure and, if satisfactory, fill and paint the interior joints.

3.2.3 No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.

3.2.4 An infiltration test may be substituted for an exfiltration test if the ground water table is above the highest joint in the concrete structure. If there is no leakage into the concrete structure as determined by the Engineer, the concrete structure will be considered water-tight. If the Engineer is not satisfied, testing shall be performed as described herein.

3.3 CLEANING

The Contractor shall thoroughly clean all new concrete structures of all silt, debris and foreign matter of any kind, prior to final inspections.

END OF SECTION

SECTION 11319

SUBMERSIBLE WELL PUMP

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor supervision, materials, equipment, and incidentals required to completely install, test, and startup the submersible well pump and associated appurtenances necessary to provide a complete and operable package.

1.1.2 Prior to submersible pump installation, the Contractor shall ensure protection of the groundwater from surface contamination by completing the well in accordance with SECTION 02525 –WELL INSTALLATION AND TESTING.

1.1.3 This section is written as a performance specification. Only basic equipment requirements are indicated. All required equipment and incidentals, including electrical and instrumentation, shall be furnished, whether specified herein or not, to produce a fully operational system.

1.2 SYSTEM DESCRIPTION

1.2.1 Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory waterworks operation at least 2 years prior to bid submittal. The pump and motor shall each be the product of one manufacturer.

1.2.2 The pump shall be an electrical submersible type constructed of corrosion-resistant 304 stainless steel and inert composites suitable for environmental applications. A motor attached below the pump section shall drive the pump. All wetted parts that will come in contact with groundwater shall be suitable for the intended purpose and shall not cause swelling because of the presence of any volatile organic compounds.

1.2.3 The pump flow rate shall be adjustable and capable of delivering the average flow of 60 gpm for EW-1S and EW-1I, and 80 -130 gpm for EW-1D at the pressures required by the treatment system. The pump sizing shall be determined by the Contractor and submitted to Engineer for approval.

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Pump Selection Calculations and Performance Data; Shop Drawings; EA

Submit pump selection calculations and corresponding manufacturer's data showing pump performance.

1.3.2 Manufacturer's Installation Instructions; Manufacturer's Instructions; FIO

1.3.3 Manufacturer's Descriptive Data; Product Data; FIO

1.3.4 Technical Literature; Product Data; FIO

Technical literature shall include materials of construction, utility requirements, equipment weight, and catalog cuts. Spare parts data shall include a complete list of parts and supplies with current unit prices and sources of supply.

1.3.5 Manufacturer's Certified Pump Curve; Product Data; FIO

The pump curve shall show pump performance characteristics including capacity, head, and horsepower requirement (when applicable) over the manufacturer's range of operation.

1.3.6 Corrosion Protection Certificate; Certificates; FIO

1.3.7 O&M Manual; Design Data; FIO

Include manufacturer's Operation and Maintenance (O&M) Manual in accordance with SECTION 01850 – FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND STARTUP TRAINING

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Product shall be packaged, shipped, delivered, handled, stored, and installed in ways that will prevent damage to the items.

1.4.2 The outside of the package or crate shall be adequately marked or tagged to indicate its content by equipment name, approximate weight, special precaution for handling, and recommended requirements for storage before installation.

1.4.3 Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

1.4.4 After hydrostatic or other tests, all entrapped water shall be drained prior to shipment and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 Selection

2.1.1.1 The contract shall be responsible for the proper selection of the groundwater pump. Pump selection shall be as approved by the Engineer based upon the Contractor's submittals.

2.1.1.2 The Contractor's extraction well pump design calculations shall clearly indicate the pumping rate and total dynamic head (TDH) requirements governing pump selection. TDH shall be understood to consist of the head elevation from the drawdown to the top of the well, friction losses in the pipe, meters, valves and fittings, and head loss in the groundwater treatment system, plus a 20% safety factor.

2.1.2 Materials and Equipment

Materials and equipment shall be as specified below, and shall be suitable for the service intended. Materials and equipment shall be new and unused, except for tests. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same manufacturer.

2.1.2.1 All parts shall be amply proportioned for all stresses that may occur during fabrication, transportation, erection, and operation.

2.1.2.2 The pump shall be suitable for both continuous and intermittent operation.

2.1.2.3 The pump shall be submersible well pump in accordance with the construction specified below in Paragraph 2.2.

2.1.2.4 A stainless steel nameplate shall be affixed to the pump. The pump model shall be stamped into the nameplate.

2.1.3 Source Quality Data

The pump manufacturer shall provide a certified shop test report. Such a report shall demonstrate that the pressure and efficiency of the proposed pump meets the capacity requirements of this Section. If available, standard test data from previously built similar units are acceptable.

2.1.4 Discharge Piping

Discharge piping shall be installed as specified in SECTION 15200 – PIPING, VALVES, AND APPURTENANCES and meet the following requirements:

- Protected against the entrance of contamination
- Properly anchored to prevent movement
- Protected against surge or water hammer
- Designed so that friction loss is low
- Chemical resistant and non-stretch

2.2 PUMP CONSTRUCTION

2.2.1 All materials and the complete installation of the pump shall comply with AWWA E101-77-B, Submersible Well Pumps, and with specific requirements established herein. The pump shall be rated for environmental duty, constructed of stainless steel and teflon-wetted parts only and be Grundfos 85S series or approved equivalent. The pump shall be of a size to fit inside the 8 inch (ID) well.

2.3 SUBMERSIBLE MOTOR

2.3.1 The pump motor shall be submersible type with a 1.15 service factor. The pump shall be able to be separated from the motor, so each can be serviced individually. Power cables to the pump motor from the terminal box shall be furnished by the pump manufacturer and shall be suitable for use in the contaminated groundwater characteristic of this site. The pump shall operate from a 460 Volt, Three-Phase, 60 Hertz power supply. Motor lead shall be replaceable.

2.3.2 The pump motor shall use a permanent magnet technology. The pump shall use a micro frequency converter to control the motor for constant pressure control, soft-start and dry run protection. Pump motors shall have a high motor efficiency over a wide operating range.

2.3.3 The pump motor shall have cooling characteristics suitable to permit continuous operation in submersed conditions at this site.

2.3.4 The pump motor shall have thermal protection in the motor windings to automatically switch off the motor if the winding temperature reaches a preset high temperature. The unit shall be capable of starting automatically after the motor cools down.

2.3.5 The pump/motor shaft shall rotate on permanently lubricated bearings properly sized to withstand the axial and radial forces. The AFBMA Minimum B-10 bearing life shall be at least 30,000 hours.

2.3.6 The pump motor shall have a soft start which reduces the starting current and provides a smooth and steady acceleration.

2.3.7 The pump motor shall be protected against dry-run, overvoltage, undervoltage, and overload.

2.3.8 The motor shall be capable of continuous variable speed control within 65% to 100% of motor speed. The pump shall be capable of being set at any duty point in the range.

2.3.9 The pump motor with its appurtenances and cable shall be capable of continuous submergence underwater without loss of watertight integrity to the depths required for service. All mated surfaces shall be machined, fitted with O-rings for watertight sealing.

2.3.10 Pump cables shall be provided of sufficient length so that the cables will be continuous between the pump and the junction box with no splices being allowed. The inner conductors shall be insulated by PVC. The junction box will be located in the well vault.

2.4 PUMP CONTROL SYSTEM

2.4.1 The pump motor shall be wired to a starter in a control panel located in the well vault. The local HOA switch and SCADA PLC will control the pump.

2.4.2 Pump control system shall be specifically designed to operate with the well pump motor selected. The controller shall operate at the manufacturer's recommended power supply requirements. The pump controller shall consist of a main breaker, lightning and surge arrester, motor circuit protector, motor starter, and fused control power transformer (sized as required by load).

2.5 LEVEL TRANSDUCERS

Level transducers for controlling the pumps shall be provided as described in SECTION 13405 – PROCESS INSTRUMENTATION AND CONTROL-PRODUCTS. The Contractor shall provide pipe for the level transducer to be mounted in.

2.6 TORQUE ARRESTOR

Torque arrestor shall be installed as recommended by the Manufacturer to help keep the pump aligned and to help prevent excessive wear and tear due to pump motor starts.

2.7 SHOP PAINTING

2.7.1 Before exposure to weather and prior to shop painting, all surfaces shall be thoroughly cleaned, dry and free from all mill-scale, rust, grease, dirt and other foreign matter.

2.7.2 Gears, bearing surfaces and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust resistant coating. This coating shall be maintained as necessary to prevent corrosion during periods of storage and erection and shall be satisfactory to the Engineer at the time of the final acceptance test.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 The pump and pumping equipment shall be installed in such manner as to prevent contaminants from entering the well.

3.1.2 The top of the casing shall be effectively sealed against the entrance of water under all conditions of vibration or movement of conductors or cables.

3.1.3 The Contractor shall provide and install the submersible well pump with internal connections and wiring, connected electrically to the power source for the extraction well.

3.1.4 The Contractor shall ensure that the method of deployment into the well does not damage pump or pressure sensor devices.

3.1.5 The electrical cable shall be firmly attached with cable ties to the riser pipe at 20-foot intervals or less.

3.1.6 The well pump shall be placed above the screened interval of each extraction well as shown on the Contract Drawing.

3.1.7 The pump shall be securely connected to a stainless steel cable to prevent the loss of the pump down the well. The top of the cable shall be securely affixed to the inside of the top of the well casing. The connector shall be water tight.

3.2 INSPECTION AND TESTING

3.2.1 General

3.2.1.1 The Engineer shall have the right to inspect, test or witness tests of all materials or equipment to be furnished under this Section, prior to their shipment from the point of assembly.

3.2.1.2 The Engineer shall be notified in writing prior to the initial shipment or testing, in ample time so that arrangements can be made for inspection by the Engineer.

3.2.1.3 The pump manufacturer shall perform the following test on each pump prior to shipment from factory:

3.2.1.3.1 Megger motor and pump for insulation breaks or moisture.

3.2.1.3.2 Prior to submergence, the pump shall be run and checked for correction rotation.

3.2.1.3.3 Pump shall be run for a minimum of 30 minutes in a submerged condition.

3.2.1.3.4 The pump shall be removed from the test tank, meggered immediately for moisture, and upper and lower seal unit shall be checked for water intrusion.

3.2.1.3.5 A written certification test report regarding the above tests shall be supplied with each pump at the time of shipment.

3.2.1.4 The services of a factory representative shall be furnished for a minimum of 1 day and shall have complete knowledge of proper operation and maintenance to inspect the final installation and supervise the test run of equipment.

3.2.1.5 Field tests shall not be conducted until such time that the entire installation is template and ready for testing.

3.2.1.6 In the event that the equipment does not meet the Final Acceptance Test, the Contractor shall, at his own expense, make such changes and adjustments in the equipment which he deems necessary and shall conduct further tests until full satisfaction is indicated by the Engineer and written certification is received thereof.

3.2.2 Pump

3.2.2.1 After the pump has been completely installed and working under the direction of the manufacturer, conduct in the presence of the Engineer such tests as are necessary to indicate that the pump conforms to this Section. Supply all electrical power, water, labor, equipment and incidentals required to complete the field tests.

3.2.2.2 The Final Acceptance Test shall demonstrate that all items of this Section have been met by the equipment as installed and shall include, but not be limited to, the following tests:

3.2.2.2.1 That all units have been properly installed and are in correct alignment.

3.2.2.2.2 That the units operate without overheating or overloading any parts and without objectionable vibration.

3.2.2.2.3 That there are no mechanical defects in any of the parts.

3.2.2.2.4 That the pumps can deliver the specified pressure and quantity of groundwater.

3.2.2.3 If the pump performance does not meet the requirements specified, corrective measures shall be taken or the pump shall be removed and replaced with a pump which satisfies the conditions specified. A 72-hour operating period of the pump will be required before acceptance.

3.2.3 Motors

3.2.3.1 Check all motors for correct clearance and alignment in accordance with manufacturer's instructions. Check direction of rotation of all motors and reverse connections if necessary.

END OF SECTION

SECTION 13122

GROUNDWATER TREATMENT BUILDING

PART 1 GENERAL

1.1 SCOPE OF WORK AND SERVICES

1.1.1 The Contractor shall furnish all professional services, labor, equipment, materials, and incidentals for the design and construction of the Groundwater Treatment Building as specified herein.

1.1.2 This Section is written as a Performance Specification. It is not the intent of this Section to specify all details of design, fabrication, construction, and operation. The Contractor shall have the ultimate responsibility for obtaining the design by a Professional Engineer or Architect registered in the State of New York, and obtaining all permits required by State and local authorities having jurisdiction. The Engineer(s) and /or Architect shall be the Engineer(s) or Architect of Record and shall produce signed and sealed design drawings and calculations for the Engineer's Review. The Contractor shall be responsible for all workmanship, materials, construction, installation, satisfactory testing and operational performance for all of the items and accessories specified herein and shown on the attached Figure. All required equipment and incidentals shall be furnished, whether specified herein or not, to produce a fully operational facility. The Engineer approval of submittals shall not relieve the Contractor of the above responsibilities.

1.1.3 The Work consists of the geotechnical investigation for foundation design, and design and construction of a new one-story Groundwater Treatment Building complete with a new parking lot, new site lighting, accessible routes and new landscaping.

1.1.4 The Engineer/Architect of Record engaged by the Contractor shall determine, with the approval of the Engineer, the final size of the building to adequately accommodate the groundwater treatment system located at the Old Roosevelt Field Superfund site, in accordance with SECTION 13300 - GROUNDWATER TREATMENT SYSTEM. The size of the building shall not exceed dimension shown on the Contract Drawing. The maximum height of the building shall be 30 feet.

1.1.5 The groundwater treatment building shall be designed to include at least one service door to accommodate equipment and maintenance, and one pedestrian door. The size, location and quantity of doors shall comply with all applicable State and local codes, rules, regulations and safe work practices.

1.1.6 The groundwater treatment building shall be designed to include a process room, chemical room, process control/electrical room, and an accessible unisex toilet room in compliance with the New York State Americans with Disabilities Act, current edition and the federal ADA.

1.1.7 The process room shall contain all of the treatment process equipment.

1.1.8 The chemical room shall contain all the chemical tanks and appurtenances.

1.1.9 The process control/office/electrical room shall contain the Programmable Logic Controller (PLC) computer workstation, office furniture and electrical equipment.

1.1.10 The building shall include equipment to allow for the easy maintenance (e.g., low-profile air stripper trays, etc.).

1.1.11 A monolithic curb for spill containment purposes shall be constructed around the perimeter of the building slab and shall be in compliance with the State and local code requirements. A monolithic curb for secondary containment shall be provided for each chemical type storage tanks. The curbs shall be of a height that will provide containment to hold a minimum of 110 percent of the volume of the largest tank in the treatment system.

1.1.12 The building shall include trench drain with sump for leak capture and detection. The building slab shall pitch to the trench drain.

1.1.13 The building shall be equipped with an eyewash station and emergency shower and shall be designed to meet all OSHA requirements as specified in 29 CFR 1910.

1.2 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.2.1 Building Layout Drawings; Pre-Construction Submittals; EA

1.2.1.1 Submit to-scale drawings with plans, elevations, cross sections, and details as necessary to show the layout of the groundwater treatment building. The drawings shall show the position, size, and arrangement of, but not be limited to, foundations, slabs, structural steel members, roof lines, treatment equipment, piping, ductwork, controls, mechanical, electrical, instrumentation, utilities, doors, windows, louvers, roof and wall penetrations, sumps, and containment structures. The drawings shall show dimensions in sufficient detail to demonstrate that the treatment system as designed in SECTION 13300 - GROUNDWATER TREATMENT SYSTEM will be sufficiently housed in the building and will meet the requirements of the specifications. Adequate detail of the architectural building appearance shall be provided to allow the Engineer to make an approval decision on the appearance of the building.

1.2.1.2 Once this submittal is approved by the Engineer, it shall be submitted to the Garden City Building Division in order to obtain the approval of the building profile, aesthetics, and relevant construction permits.

1.2.2 Structural Drawings and Specifications; Pre-Construction Submittals; EA

The drawings shall include Structural Drawings, signed and sealed by the Project's Structural Engineer of Record (EOR). The EOR shall be a Professional Engineer in the State of New York and shall be responsible for the foundation and building design in accordance with the local codes as well as coordination between disciplines. A delegate structural engineer may be used for any component design designated by the EOR but the EOR retains responsibility for the project. EOR shall review all design and calculations performed from any delegate engineer (if applicable). All drawings and calculations shall be signed and sealed by the appropriate party (delegate engineer or EOR) and sent to the Engineer for Review. Drawings shall include the following:

1.2.2.1 A Project and Site Specific Geotechnical Report, Signed and Sealed by a NY Professional Engineer.

1.2.2.2 Groundwater Treatment Building Shop Drawings, signed and sealed by a Professional Engineer, licensed in the State of New York.

1.2.2.3 Foundation Design for groundwater treatment building, containment curbs and structure, and all other miscellaneous structural items signed and sealed by the project's structural EOR. These drawings shall include the appropriate reference to the Geotechnical report and data and the groundwater treatment building design and drawings as required by the applicable building code. Submit calculations for the entire building including foundation. All calculations shall be signed and sealed by a New York State Registered Professional Engineer or Architect.

1.2.3 HVAC, Plumbing, and Fire Protection Drawings and Specifications; Pre-Construction Submittals; EA

The drawings shall include HVAC, Plumbing, and Fire Protection Drawings, signed and sealed by the Project's Mechanical EOR. The EOR shall be a Professional Engineer licensed in the State of New York and shall be responsible for the HVAC, Plumbing, and Fire Protection system design in accordance with the local codes and regulations, as well as coordination between disciplines. The following additional calculations shall also be performed:

1.2.3.1 Signed and sealed fire protection hydraulic calculations.

1.2.3.2 Signed and sealed energy code compliance forms /calculations if required by the Garden City Building Department.

1.2.3.3 Heating and cooling load calculations as well as ventilation calculations shall be performed considering the ambient site conditions, the dimensions of the building, the building envelope heat gains, heat generated by equipment within the building, and all requirements of the 2007 New York State Mechanical Code. Outdoor air ventilation shall be provided for each space as required by ASHRAE 62.

1.2.4 Shop Drawings; Shop Drawings; EA

Submit shop drawings and the manufacturer's specifications and catalog information for all components, accessories, and fasteners. Submit equipment and material cut sheets for all HVAC, Plumbing, and Fire Protection equipment and accessories. Provide vendor computer selections and performance selections for the HVAC equipment provided. The building manufacturer shall submit a letter of confirmation that this Section has been reviewed and that the manufacturer can provide a building conforming to the specified requirements.

1.2.5 Color Samples; Samples; EA

The color of all components including, but not limited to, the roof, walls, and trim of the building will be selected by the Engineer from Manufacturer's standard color chip literature. Submit samples of actual finish on representative metal samples in available colors.

1.2.6 P.E. Certification; Certificates; FIO

Records shall be submitted as follows:

1.2.6.1 An original and three copies of a completed P.E. Certification Form, signed and sealed by a professional engineer registered in the State of New York shall be submitted prior to installation.

1.2.6.2 One set of reproducible design drawings for the groundwater treatment building, sealed by the registered professional engineer. Dimensions and sizes of all structural members shall be shown on the drawings.

1.2.7 Erection Drawings; Shop Drawings; EA

Submit complete erection drawings and installation instructions, showing anchor bolt and base plate settings; bracing; and sections and details of openings, covering, and trim.

1.2.8 Manufacturer's Certifications; Certificates; FIO

1.2.8.1 Submit certification of the manufacturer's compliance with AISC-MB category.

1.2.8.2 Submit certification of welder qualifications, if requested by the Engineer.

1.2.9 Warranty; Certificates; FIO

The Contractor shall provide copies of warranties for equipment covered under this Section.

1.2.10 Sanitary Waste Holding Tank Permit; Certificates; FIO

Submit copies of the sanitary waste holding tank permit obtained from Nassau County Department of Health Services.

1.3 CODES AND STANDARDS

1.3.1 Work shall be completed in accordance with the latest editions of all local, state and national codes for permitting through applicable agencies, including but not limited to: New York State Building Code, New York State Fire and Property Maintenance Codes, New York State Energy Conservation Construction Code and the New York State Plumbing, Mechanical, and Fuel Gas Codes; Americans with Disabilities Accessibility Guidelines for Buildings and Facilities (ADAAG); and Occupational Safety and Health (OSHA) Regulations.

1.3.2 A code search shall be conducted for this Project, and the building code data and life-safety plan shall be provided on the drawings filed for permit.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 The Contractor shall deliver, store, and handle building components, and other manufactured items so they will not be damaged or deformed. Materials on platforms or pallets shall be stacked and covered with a weather-tight ventilated covering to keep the materials off the ground and away from moisture. Do not store materials in contact with other materials that will cause staining.

1.4.2 Caulking and sealing compounds shall be delivered to the job in unbroken, sealed containers bearing the manufacturer's mixing directions. Materials shall be stored in sealed containers in a dry protected area above the ground or floor. Materials shall be stored above 40 degrees F.

1.5 DESIGN CRITERIA

1.5.1 All components of the building shall meet the minimum design loads listed in the 2007 New York Building Code and local amendments and as specified in Paragraph 2.2.

1.5.2 Design shall take in consideration equipment that may need to facilitate equipment replacements or other maintenance activities to the treatment components.

1.5.3 Building footprint and clear inside wall height shall be sufficient to house the groundwater treatment system as specified in SECTION 13300 – GROUNDWATER TREATMENT SYSTEM.

1.5.4 Outdoor Design Conditions for Nassau County, NY
Summer: 89^0F Dry-Bulb 73^0F Wet-Bulb
Winter: 13^0F Dry-Bulb
Approximate Heating Degree Days: 4910

Heating and ventilation units shall be supplied to maintain the following conditions in the process and chemical storage rooms:

1.5.4.1 Winter Space Temperature: 55 ^{0}F minimum.

1.5.4.2 Summer Space Temperature: 104 ^{0}F maximum.

1.5.4.3 Process Room: Minimum number of air changes (continuous) - 1 cubic feet per minute (CFM) per square foot.

1.5.4.4 Chemical Storage Room: Minimum number of air changes (continuous) - 1.5 cubic feet per minute (CFM) per square foot.

1.5.5 Heating and air conditioning units shall be supplied to maintain the following conditions in the process control/electrical room and toilet room:

1.5.5.1 Winter Space Temperature: 68^{0}F minimum.

1.5.5.2 Summer Space Temperature: 75^{0}F maximum.

1.6 DESIGN CALCULATIONS

1.6.1 The structural EOR shall submit the following: geotechnical report, groundwater treatment building calculations and column reactions, and foundation design calculations including foundation, building slab, containment curbs, and all miscellaneous structural items. All calculations shall be signed and sealed by the appropriate party.

1.6.2 The mechanical EOR shall submit the following: fire protection hydraulic calculations, heating/cooling and ventilation calculations and energy code compliance forms/ calculations shall be submitted if required by the Garden City Building Division. All calculations shall be signed and sealed by the appropriate party.

1.7 WARRANTY

1.7.1 Contractor is to provide standard manufacturer's warranty on parts and components installed in building and equipment.

1.7.2 The Contractor shall issue a one (1) year warranty against defects in installed materials and workmanship, beginning from date of substantial completion and acceptance by the Engineer.

PART 2 PRODUCTS

2.1 BUILDING GENERAL

2.1.1 The new groundwater treatment building is to be a conventional built building. The aesthetic will present a clean, maintenance free exterior consistent with the adjacent community. Materials and finishes, including roofing, siding, windows and doors shall not be incompatible with the local surrounding. Exterior architectural features and colors shall be compliant with local planning and zoning ordinances.

2.1.2 Treatment Building shall be completed as specified herein and to include, but not be limited to:

2.1.2.1 Foundation and concrete slab designed by a New York registered Professional Engineer or Architect. The foundation design shall be based upon the information contained in the geotechnical report.

2.1.2.2 The building slab area shall be constructed with a 6 inch thick 10,000 psi concrete sacrificial topping or approved equal. The balance of the concrete slab shall be 4,500 psi.

2.1.2.3 Cold-formed metal framing, including exterior and interior load-bearing wall framing, non-load-bearing wall framing, roof and floor joist framing, and ceiling and roof rafter framing.

2.1.3 The products, materials and assemblies, including anchorage shall comply with project specific calculated design pressures and to the New York State Building Code (Code), including wind design criteria. Where a conflict occurs between the requirements stated in this document and the Code, the more stringent requirement shall apply.

2.1.4 This treatment building shall meet all requirements of the New York State Accessibility Code for and the Americans with Disabilities Act. The facility must be readily accessible to and usable by individuals with disabilities and to include, but not be limited to, convenient accessibility to parking areas, entrances, and common areas as well as usable toilet rooms and water fountains.

2.2 COLD-FORMED METAL FRAMING

2.2.1 Cold-Formed metal framing shall meet all applicable standards of the American Iron and Steel Institute (AISI), American Welding Society, ASTM, Light Gauge Steel Engineers Association, and the Society for Protective Coatings (SSPC). Cold-Formed metal framing shall be designed in accordance with the following standard:

2.2.1.1 Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

2.2.1.2 Design headers according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."

2.2.1.3 Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

2.2.1.4 Design roof trusses according to AISI's "Standard for Cold-Formed Steel Framing - Truss Design."

2.2.2 Drawings, specifications, design calculations, and other structural data shall be prepared by a qualified professional engineer licensed in the State of New York and is qualified in this type of structural design.

2.2.3 Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

2.2.4 Performance Requirements shall be in accordance with the building code in effect at the time that the contract is awarded or the permit application (whichever is later).

2.2.4.1 Minimum Design Loads:

2.2.4.1.1 Dead Loads: actual dead load of equipment

2.2.4.1.2 Live Loads: 200 psf minimum floor live load

2.2.4.1.3 Roof Loads: 30 psf minimum roof live load plus actual dead load

2.2.4.1.4 Snow Loads: shall be calculated in accordance with the building code

2.2.4.1.5 Wind Loads: shall be calculated in accordance with the building code

2.2.4.1.6 Seismic Loads: shall be calculated in accordance with the building code

2.2.4.2 Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

2.2.4.2.1 Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height.

2.2.4.2.2 Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 10 lbf/sq. ft.

2.2.4.2.3 Roof Trusses: Vertical deflection of 1/360 of the span.

2.3 DOORS AND WINDOWS

2.3.1 Personnel doors shall be hollow metal constructed of minimum 16 gauge and all-welded frames a minimum 14 gauge galvanized steel sheets complying with ASTM A526 and ASTM A525, G60 zinc coating. Doors and frames painted for dry non-corrosive areas. For wet or corrosive areas use aluminum doors and frames.

2.3.1.1 Fire-rated assemblies shall be provided in accordance with Code requirements and assemblies will comply with NFPA Standard No. 80. Doors and frames will be factory prime finished.

2.3.2 Exterior roll-up doors shall be interior face mounted, motor operated. The door curtain shall be constructed of interconnected strip steel slats. Interior and exterior slat shall be 22 gauge separated by 13/16-inch of rigid insulation. Provide windlocks of same material as required to meet wind load requirements of the Building Code.

2.3.2.1 The motor shall be size as required by the door, 480 volts three-phase and include a magnetic reversing starter. The motor operator shall be activated by a 3 button push-button station in a NEMA 1 enclosure. All motor operators shall be U.L. listed.

2.3.2.2 The hood shall be fabricated from 24 gauge galvanized steel and shall be formed to fit the curvature of the brackets.

2.3.2.3 Provide approved neoprene weather stripping at interior on each guide and in hood.

2.3.2.4 Provide approved heavy duty slide bolts with padlocking capability at both jambs, locking into cutouts in guides.

2.3.3 Hardware will be in compliance with Builders Hardware Manufacturers Association (BHMA). Furnish door hardware that meets the requirements of ADA.

2.3.3.1 Personnel door hardware will include lock/latch sets, closers, exit devices, silencers and push, pull and kick plates as required.

2.3.3.2 Roll-up door hardware will include track(s), slides, rollers, latches, and stops as required.

2.3.4 Windows shall be fixed, hollow metal frames of minimum 14 gauge all-welded galvanized steel, , complying with ASTM A526 and ASTM A525, G60 zinc coating.

2.3.4.1 Fit exterior windows with 1 in. insulated glass.

2.3.4.2 Fit interior windows with chemical-resistant, sound control glazing.

2.3.5 Louvers shall be aluminum with factory-applied polyvinilidene diflouride (PVDF) enamel finish.

2.4 INSULATION AND MOISTURE PROTECTION

2.4.1 Insulation and vapor barriers shall meet applicable energy and building codes, and installed in accordance with good building practices.

2.4.1.1 Perimeter insulation shall be a minimum 2 inch thick extruded closed cell polystyrene foam board.

2.4.1.2 Exterior wall insulation shall be batt insulation, or acceptable substitute, in sufficient thickness to meet the required "R" factor.

2.4.1.3 Ceiling and/or roof insulation shall be batt insulation, or acceptable substitute, in sufficient thickness to meet the required "R" factor.

2.4.1.4 Vapor barrier shall be a minimum of 10 mil thick polyethylene sheet with a vapor transmission rating of 0.20 perms or less. Provide with approved pressure sensitive polyethylene tape to seal joints.

2.5 INTERIOR MATERIALS AND FINISHES

The following information shall provide guidance for the selection of interior finishes. The final interior finishes shall be approved by the Engineer.

2.5.1 Flooring

2.5.1.1 Office and Toilet Rooms shall be vinyl composition tile with no asbestos. Tile shall be 12-in by 12-in by 1/8-in, fire-retardant (flame spread rating of 25 or less), thoroughly resistant to alkali, grease and oils, and shall conform to ASTM 1066 Comp.1; Class 2 through pattern.

2.5.1.2 All other areas shall be concrete with a liquid-tight, chemical resistant coating, suitable for frequent splash or prolonged exposure to concentrated vapors.

2.5.1.2.1 Surface shall be resistant to daily personnel foot traffic and movement of storage drums and pallets, totes and pallet jacks.

2.5.1.2.2 Surface shall be skid resistant.

2.5.1.2.3 Chemical resistance: Method Immersion at 75°F (24°C) in accordance with NACE Tm-01-74, Procedure B, Hydrochloric Acid, 10%; Calcium Chloride, 25%; Sulfuric Acid, 30%; Ethylene Glycol; Chromic Acid, 10%; Skydrol; Nitric Acid, 10%; Corn Syrup; Ammonium Hydroxide, 28%; Sour Crude Oil.

2.5.2 Walls

2.5.2.1 Interior partitions shall be metal studs and moisture-resistant (MR) gypsum board walls. Paint gypsum board walls with eggshell finish 100% acrylic latex emulsion paint.

2.5.2.1.1 Fire-rated wall assemblies shall be provided in accordance with the NYS Building and Fire Prevention Code requirements.

2.5.2.1.2 Toilet Room interior walls shall be same composite panel used in the process area.

2.5.2.2 Interior face of exterior walls shall be a composite panel with a smooth melamine face. Mechanically fasten the panels to the wall studs and cover all seams with sealant and vertical and horizontal trim covers to hide the joints.

2.5.3 Ceilings

2.5.3.1 Suspended Ceilings shall be installed in the Process Control and Toilet Room. They shall be acoustical tile lay-in with a minimum NRC of 60, light reflectance of 0.86, humidity resistant, and a factory applied vinyl latex finish. The suspension system shall be exposed T-grid cold rolled steel. Acoustical tile and suspension system shall be by one manufacturer.

2.5.3.2 All other areas will be exposed structure.

2.6 EXTERIOR MATERIALS AND FINISHES

The intent of this document is to provide a basis of design for the new Groundwater Treatment Building. The exterior aesthetic is to blend with the immediate community in materials used, colors selected and scale when feasible. Attached Figure provides a conceptual aesthetic. The following is presented as a guide for the exterior components and finishes. The Village of Garden City shall have final approval of all exterior components and finishes.

2.6.1 Exterior metal siding shall 18 gauge galvanized steel, horizontal siding with an 8 inch exposure pattern. Panels shall be interlocking with concealed fasteners, gaskets and all accessories for a complete watertight installation.

2.6.1.1 Exterior sheathing shall be a moisture-resistant core with fiberglass mat facings to resist the effects of moisture i.e. DensGlass as manufactured by Georgia Pacific.

2.6.2 Exterior wood shingle walls shall be smooth-sawn western red cedar shingles, Grade: No. 1, 16-in (405 mm) long; 5 shingles, 2-in (51 mm) thick at butt.

2.6.2.1 Provide fire-retardant, pressure-treated units with a Class C fire-test-exposure roof covering rating.

2.6.2.2 Provide 0.40 CCA pressure-treated units as prevention against decay.

2.6.3 Brick veneer shall be a thin brick product applied to an appropriate weather resistant barrier using standard metal lath, scratch coat and mortar application.

2.6.4 Roofing material shall be heavyweight, granule surfaced, self sealing asphalt shingle with a fiberglass reinforced core and a mineral granule surfacing. Architectural laminate styling to provide a wood shake appearance with a 5-inch exposure. Shingles shall be Class A-UL790 rated meeting ASTM D7158, class H, and ENERGY-STAR rated.

2.6.4.1 Shingles color shall be as selected by the Engineer from the manufacturer's standard color pallet.

2.6.4.2 Hip and Ridge cap shingles, matching the color of selected roof shingle, shall be self sealing universal ridge cap shingles.

2.6.4.3 Plywood used in roof construction shall be either C-D EXT-APA Grade or B-C EXT-APA Grade when one surface is exposed and preservative treated.

2.6.4.4 Underlayment shall be asphalt saturated organic felt or approved equal complying with ASTM D226.

2.6.4.5 Perimeter underlayment shall be a polyethylene-sheet-backed, self adhering, bituminous sheet complying with ASTM D1970, installed at a minimum of 24 inches around entire perimeter.

2.6.5 Sheet Metal Flashing shall be aluminum sheet to meet ASTM B209, alloy 3003, temper H14, mill finish, at a minimum of 0.040-in thick. Fabricate sheet metal flashing to comply with SMACNA's "Architectural Sheet Metal Manual".

2.7 GUTTERS AND DOWNSPOUTS

2.7.1 Gutters and downspouts shall be shown on the drawings and shall be constructed of galvanized steel equal to ASTM A653 with G90 coating ready for prefinish.

2.7.2 The Contractor shall furnish and install preformed galvanized steel corner closures matching the configuration of the gable trim and gutter.

2.7.3 The Contractor shall furnish and install preformed rubber weather seals to completely fill roof corrugation voids prior to gutter installation.

2.7.4 The Contractor shall furnish and install preformed galvanized steel wall closures to close corrugations in panel walls prior to gutter installation.

2.7.5 Gutter and downspout color shall match the selected color of the wall panels, and shall be approved by the Engineer.

2.8 HEATING, AIR CONDITION AND VENTILATION (HVAC)

2.8.1 Refer to Paragraph 1.2.3 for HVAC system design calculation requirements. Refer to Paragraphs 1.5.4 and 1.5.5 for Outdoor and Indoor design conditions.

2.8.2 Process and Chemical Storage Room

2.8.2.1 The space will include chemical storage tanks in the chemical storage room. The Process Room shall be continuously ventilated based on the requirements of the New York Mechanical Code, at a minimum of 1 CFM/square foot. The chemical storage room will be ventilated based on the requirements of the New York Mechanical Code and the New York Fire Code, at a minimum of 1.5 CFM/Square foot. Ventilation for both rooms shall be provided by roof mounted, wall mounted, or inline exhaust fans. Discharge locations shall meet the requirements of the New York Mechanical Code. Tempered make-up air shall be provided by a packaged make-up air unit or supply fan. The space shall be maintained at negative pressure relative to adjacent spaces and the exterior. Heating systems shall be electric, integral to the packaged make-up air unit or a duct heater for the supply fan. Supply and exhaust ductwork shall be provided to ensure adequate ventilation throughout the space.

2.8.2.2 Additional emergency ventilation shall be provided at a minimum rate of 12 air changes per hour. Emergency ventilation shall be activated by the PLC under the following conditions; triggering of high level switches in the chemical storage tank containments; triggering of the blower discharge line low pressure gage; if the room vapor monitor (RVM) detects high vapor concentrations as defined in Paragraph 2.15.1.1.3; or by a manual wall switch located at each entrance to the space.

2.8.3 Additional ventilation shall be provided to maintain a temperature rise above ambient of no more than 10 °F. This ventilation may be provided by the emergency ventilation system if adequate.

2.8.4 A manual break-glass type shutoff control shall be provided outside the space, labeled "VENTILATION SYSTEM EMERGENCY SHUTOFF." This control shall be integrated with the PLC and shutoff all ventilation systems in the space.

2.8.5 Ductwork shall be aluminum or stainless steel conforming to Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards.

2.8.6 Fans and make up air units shall be approved by the Engineer. All equipment shall be aluminum (when available), and provided with stainless steel hardware, corrosion resistant air dried phenolic coatings, Heresite, or equal as approved by the Engineer.

2.8.7 Process Control/Electrical Room and Toilet Room

2.8.8 Heating and air conditioning systems shall be provided as required to maintain space temperature within the space between 68° F winter and 75° F summer at design conditions. Heating systems shall be duct mounted electric heaters. Air conditioning systems shall be spilt system or packaged direct expansion systems. Outdoor air ventilation shall be provided as required by the New York Mechanical Code and ASHRAE 62. Air filtration systems shall be provided considering the surrounding site conditions. Each system shall be provided with an electronic, automatic change over thermostat. Each unit shall be provided with dipped and baked corrosion resistant coil coatings, and air dried phenolic corrosion resistant cabinet coatings, Heresite, or equal as approved by the Engineer. Each unit shall be provided with stainless steel hardware. Supply, return, and outside air ductwork shall be provided to ensure proper air distribution to the space.

2.8.9 Toilet room shall be ventilated per the requirements of the New York Mechanical Code and ASHRAE 62. Fans shall be roof mounted, wall mounted, or inline. Discharge location shall meet the requirements of the New York Mechanical Code. Equipment and ductwork shall conform to the requirements of Paragraphs 2.8.5 and 2.8.6.

2.9 ELECTRICAL FIXTURES AND LIGHTING

The Contractor shall provide all electrical fixtures, lighting and fixture accessories/components to the building in accordance with SECTION 16000 - ELECTRIC - GENERAL PROVISIONS and SECTION 16402 - ELECTRICAL WORK, INTERIOR.

2.10 TELEPHONE

The Contractor shall provide telephone system within the building in accordance with SECTION 16721 – TELEPHONE SYSTEM.

2.11 TOILET ROOM

2.11.1 A toilet room, containing a toilet and a sink, shall be located inside the building. The room shall be supplied with potable water services, including hot water. Sanitary waste shall be stored in an onsite sewage disposal system. The toilet room shall not include or connect to an on-site sanitary waste disposal facility. The Contractor shall arrange for a periodic cleaning of the sewage disposal system. The Contractor shall be responsible for obtaining a permit from Nassau County Department of Health Services for the sewage disposal system.

2.11.2 The toilet room and all fixtures and accessories shall conform to the NYS Americans with Disabilities Act and the Federal Americans with Disabilities Act Accessibility Guidelines (ADAAG).

2.12 PLUMBING

The building shall include potable and protected water services, including cold water, hot water, tempered water, sanitary drainage, plumbing fixtures and equipment. The Process and Chemical Storage Rooms shall include an emergency shower/eyewash station. Drainage systems shall be provided in the Process room as described in other sections of this specification. Refer to Section 2.11 for requirements of the Toilet Room. Emergency fixtures shall be provided with tempered water. All plumbing work shall be performed in accordance with New York Plumbing Code and shall meet the requirements of the local authority.

2.13 SECURITY SYSTEM

2.13.1 The building shall be equipped with a commercial intrusion detection security alarm system, which detects entry into the building, broadcasts a local alarm of sufficient volume to cause an illegal entrant to abandon a burglary attempt. Through the PLC, the intrusion alarm shall initiate communication with a security company in addition to the system operator.

2.14 The exterior of the building shall be equipped with a security surveillance system to monitor access to the Site from Clinton Road. The security surveillance system shall consist of a security camera, digital video recorder and flat panel LCD monitor. The security camera shall be at minimum, outdoor color high resolution with auto varifocal lens or as approved by the Engineer.

2.15 MISCELLANEOUS APPURTENANCES

2.15.1 Room Vapor Monitor

2.15.1.1 The Contractor shall provide a room vapor monitor (RVM) for detection of VOCs and shall be integrated with the PLC. The room vapor monitor shall be mounted in the treatment building to detect the release of VOCs in the building. The room vapor monitor shall, at minimum meet the following requirements:

2.15.1.1.1 The RVM shall allow for accurate monitoring of room concentration levels of VOCs for conditions that ranges from 30 degrees F to 120 F.

2.15.1.1.2 The RVM shall be furnished with calibration kit with all equipment, gas cylinders, fittings, and tools necessary for calibration.

2.15.1.1.3 The RVM shall be programmed such that the high vapor concentration alarm set point shall be set at 25 ppm.

2.15.1.1.4 The blue beacon light shall be supplied and mounted on the exterior of the building. When a high level of VOCs detected, the light shall be activated.

2.16 FIRE PROTECTION

2.16.1 The building shall include a fire suppression system that is compatible with the materials and products within the building. This system shall be designed, installed, and tested in accordance with current NFPA Standards, the requirements of local authorities, and the Government Insurance Underwriters.

2.16.2 The design of the system shall be completed by a New York licensed professional engineer. Refer to Section 1.2 for additional requirements.

2.16.3 Through the PLC, the fire alarm shall initiate communication with a security company in addition to the system operator.

2.17 LIGHTNING PROTECTION SYSTEM

The lightning protection for the building shall be installed in accordance with SECTION 16502 - LIGHTNING PROTECTION SYSTEM.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Building erection shall conform to the AISC Code of Standard Practice, the approved erection drawings, and the building manufacturer's installation instructions.

3.1.2 The groundwater treatment building shall not be erected until:

3.1.2.1 Foundation and building design have been submitted to and approved by the Engineer.

3.1.2.2 The foundation work, plumbing, and other incidentals required to be constructed prior to the building installation have been inspected and approved by the Engineer.

3.2 PREPARATION

3.2.1 The Contractor shall be responsible for final coordination of the Contract Documents with the information provided by all Engineers and Architect of Record including but not limited to the following:

3.2.1.1 Coordination of foundation dimensions, both horizontal and vertical, including: overall building dimensions, door blockouts, connections to foundation, and anchor bolt locations and quantities.

3.2.1.2 Review of the required building construction sequence and scheduling of work by other trades.

3.2.1.3 Final checks, both before placing of concrete and before commencing erection of the building.

3.3 ERECTION

3.3.1 The Contractor is responsible for ensuring that all safety procedures for the erection of the building are strictly enforced and that any required ties, stays, and temporary supports are positioned as necessary to keep the structure stable and secure at all times.

3.3.2 Installation of Joint Sealants

3.3.2.1 Caulk all exterior wall joints, between adjacent materials, joints between frames or louvers and adjacent materials, copings, and all other joints required for the completion of the work.

3.3.2.2 Caulk interior joints where required for weather tightness or neat appearance.

3.3.2.3 All joints to receive sealant shall be cleaned, primed, back filled, caulked, and tooled in complete accordance with the manufacturer's instructions.

3.3.2.4 Do not proceed with the installation of sealants under adverse weather conditions, when joint to be sealed is damp, wet, or frozen, or when temperatures are below or above the manufacturer's recommended limitations for installation.

3.3.2.5 Joint sealant shall be applied generally to a square section configuration. Minimum depth of joint shall be ¼ inch and maximum ½ inch. For joints greater than ½ inch wide, provide sealant in a 2 to 1 width-to-depth ratio.

3.3.2.6 Place all exterior door thresholds and window sills in a full bed of sealant during setting procedures.

3.3.2.7 The surfaces of all materials adjoining joints shall be cleaned free of all smears of sealant or other soiling due to caulking operations.

3.3.2.8 Properly seal all wall penetrations, such as pipe penetrations, for weather tightness.

3.3.3 Throughout erection, remove rubbish, debris, and waste material.

3.3.4 Provide all necessary repair and touch up work required as a result of damage to building components due to required cut-outs, penetrations, or by mishandling prior to and during erection.

3.4 DOORS

3.4.1 Doors and components shall be installed and adjusted in accordance with the the approved shop drawings. Locate power units and hand chains to left of (as viewed from exterior) and above doors as approved. Fire doors shall be installed to meet label requirements.

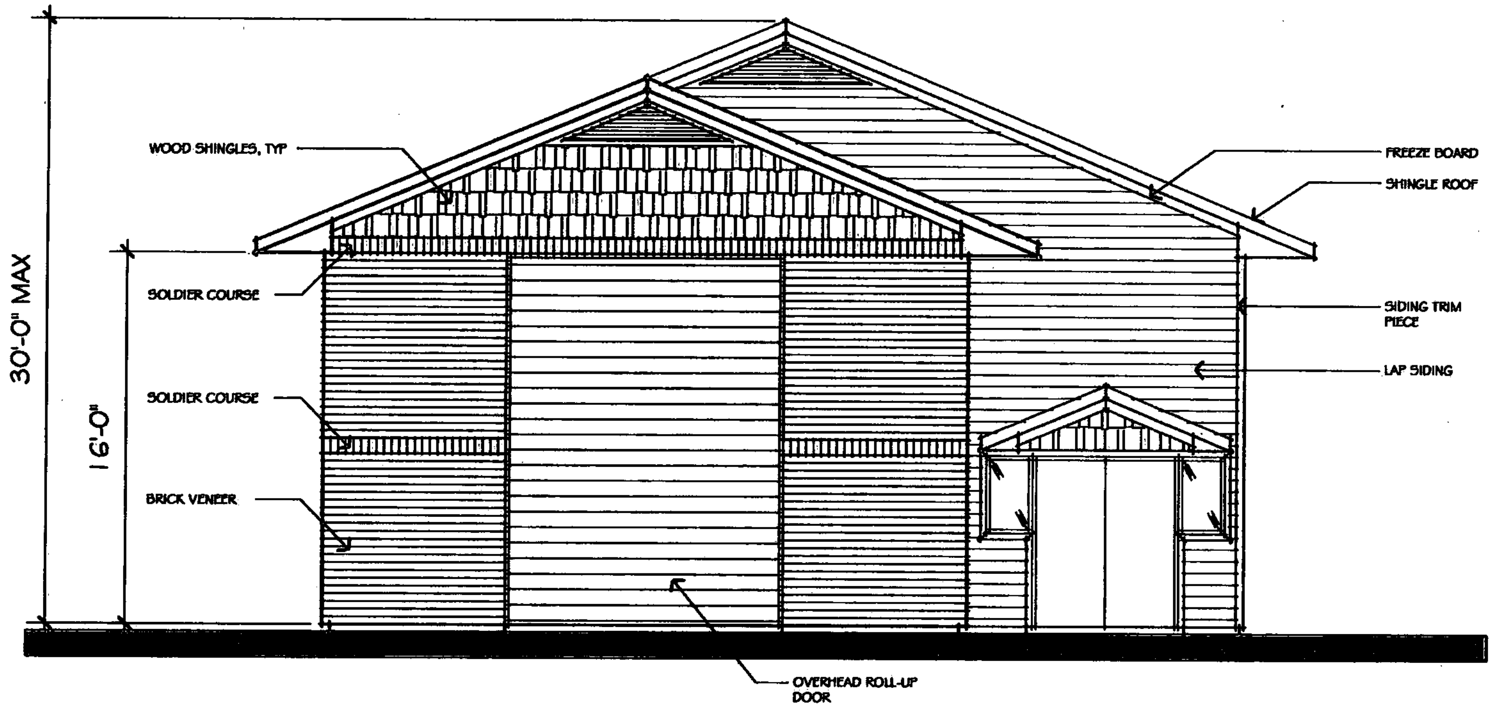
3.4.2 The Engineer shall test doors for full and effective operation. Door shall be tested in manual and electric operation.

3.4.3 The Contractor shall make required adjustments to provide operation as approved.

3.5 SECURITY

The Contractor shall obtain the services of a security company to manage fire and intrusion alarms.

END OF SECTION



FRONT ELEVATION

SCALE: 1/8" = 1'-0"

CDM

OLD ROOSEVELT FIELD SUPERFUND SITE
GROUNDWATER TREATMENT BUILDING

SEPTEMBER 2009

SECTION 13300

GROUNDWATER TREATMENT SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, supervision, engineering, design, construction, erection, chemicals, equipment, tools, necessary fabrication, materials, installation, startup, testing, and other services as specified for the construction and proper operation of a groundwater treatment system for one year.

1.1.2 This section is written as a "performance based" specification. Only basic process requirements are indicated, along with required effluent characteristics and expected influent characteristics. It shall be the Contractor's responsibility to design and construct a system to consistently treat the influent water and produce the required effluent water quality. All required equipment and incidentals, including electrical and instrumentation shall be furnished, whether specified herein or not, to produce a fully operational system.

1.1.3 This section also addresses the OPTIONAL WORK that is described in Section 1.1.4 and 2.2.7 of this specification. The OPTIONAL WORK includes iron removal system and associated sludge handling system. This phase of the project will only be implemented if iron removal system is deemed to be required to meet the iron effluent discharge criteria based upon the sample data collected after installation of extraction wells in accordance with SECTION 02525 - WELL INSTALLATION AND TESTING.

Based on the groundwater modeling results, groundwater will be extracted from three wells to target/capture the 100 μg/L and above total chlorinated volatile organic compound (VOC) plume. Groundwater modeling results indicate that three extraction wells pumping at a combined rate of 200 gpm would achieve that goal. The treatment system is intended to provide treatment of the extracted groundwater and to meet the effluent requirements prior to discharging to Nassau County recharge basin number 124. The Contractor shall design the treatment system in accordance with the following:

- A treatment system using an air stripper to treat chlorinated VOC contaminated groundwater.
- The design flow rate for the system is 200 gpm based on the groundwater modeling results. However, the Contractor shall provide an extraction and treatment system capable of continuously extracting and treating a minimum of 150 gpm, with a maximum of up to 250 gpm of contaminated groundwater to account for variability in the subsurface.
- The effluent must meet the treatment objectives specified herein and comply with New York State Department of Environmental Conservation State Pollution Discharge Elimination System (NYSPDES) permit equivalent. Discharge targets are provided in Table 13300-1 for the Contractor's reference only.
- Based on the influent concentrations presented in Table 13300-1, vapor phase treatment is not expected to be required to meet NYSDEC air pollution control requirements.

However, it is the Contractor's responsibility to comply with NYSDEC air emission requirements.

- Treated groundwater shall be discharged to recharge basin 124 via a 48 inch stormwater pipe as shown on the Contract Drawings. The Contractor shall be responsible to verify the 48 inch line connection to the Nassau County recharge basin number 124 prior to connection to this stormwater pipe.
- Minimum process instrumentation and control philosophy are provided in Table 13300-2 and Attachment A. The extraction and treatment systems must be capable of automated process operation and control, protecting process equipment from damage, providing alarms locally and remotely to the operator(s), automatic shut down of the equipment and system during upset conditions, and preventing unforeseen hazardous and undesirable conditions associated with groundwater treatment system operations.
- Minimum uptime of 90 percent during normal operation, excluding downtime associated with uncontrollable conditions (e.g., power outages).
- Design life of 30 years for the facility.
- Other requirements, as specified herein and shown on the Contract Drawings.

1.1.4 Upon completion of the installation of extraction wells, the Contractor shall determine the actual influent iron concentration, the necessity for iron treatment system to meet the NYSPDES discharge criteria and to prevent iron fouling in the air stripper and pipes. The Contractor shall perform a pilot study using extracted groundwater to determine the proper iron treatment technology. Based on the estimated influent iron concentration shown in Table 13300 – 1, greensand filtration system is considered as the representative iron treatment process. However, it is the Contractor's responsibility to propose the appropriate iron removal technology and obtain the Engineer's approval. In the event that influent iron concentration is less than NYSPDES permit requirement, but is anticipated to cause fouling at the air stripper, the Contractor shall propose the most cost effective iron treatment technology and obtain the Engineer's approval.

1.1.5 The Contractor shall be responsible for the operations and maintenance (O&M) of groundwater treatment systems for one year in a manner that accomplishes the required treatment standards and is in accordance with all Federal, State and local laws, and in accordance with SECTION 01800 – TREATMENT SYSTEM OPERATION AND MAINTENANCE and the approved O&M manual. The Contractor shall also be required to monitor system performance and maintain operating records of system performance that adequately document the required treatment.

1.1.6 The treatment system will be constructed inside of a treatment building, as specified in SECTION 13122 – GROUNDWATER TREATMENT BUILDING.

1.1.7 Contractor shall ensure that the building design meets the local building, fire, and electrical code, and any other state or local code requirements that may be applicable. The Contractor shall also be responsible for obtaining the necessary building inspections, permits, approvals, and certificates as required by local building code officials and authorities.

1.1.8 The Contractor shall provide utility hook-ups including potable water, electrical power, phone and internet lines. Electricians and plumbers licensed in the State of New York are required to supervise the completion of the works and to certify the works are completed according to the codes.

1.2 SUBMITTALS

A Professional Engineer registered in the State of New York shall seal drawings, design information, and calculations. Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.2.1 Pilot Testing Plan; Pre-Construction Submittals; EA

The Contractor shall submit a Pilot Testing Plan, if necessary, for iron treatment system. The pilot testing plan shall specify the recommended iron treatment technology(ies) to be tested, the configuration of the pilot testing system(s), the sampling and analysis plan, and how the data will be used for the iron treatment system design. Chemical doses and iron sludge precipitation characteristic shall also be included in the testing plan.

1.2.2 Groundwater Treatment Plan; Pre-Construction Submittals; EA

Within 45 working days, after the approval of influent concentrations provided by the Contractor, the Contractor shall submit a Groundwater Treatment Plan, including facility layout drawings, sections, and details to install, maintain, and operate the groundwater treatment facility. As a minimum, the plan shall include the components listed in the following paragraphs:

1.2.2.1 Groundwater Treatment Equipment; Product Data; EA

The Contractor shall submit a complete list of equipment and material used in the groundwater treatment system. The list shall include, but not limited to primary process equipment, pumps, tanks, treatment units, chemical feed systems, sludge handling systems, control valves, flow monitoring instruments, level control instruments, mixers and other similar items of equipment. The list shall include the following for each piece of equipment, as applicable:

- Manufacturer's specifications, literature, catalog cuts, and model number
- Overall horizontal and vertical dimension data on the equipments and peripherals, including lateral and overhead clearance requirements for operation, assembly/disassembly and maintenance of the equipments
- Design parameters and conditions including capacity, flow rates, pressures, temperatures, volumes, etc.
- Performance charts and curves
- Materials of construction and weight
- Installation instructions for all equipment and components
- Utility requirements

1.2.2.2 Process Flow and Instrumentation Diagrams; Shop Drawings; EA

The Contractor shall submit a process flow and instrumentation diagram (PID) showing all major pieces of process equipment, interconnecting piping, valves, pumps, instrumentation and controls to demonstrate that the system has been coordinated and will properly function as a unit.

1.2.2.3 Plan and Cross-Sectional View of Treatment System Layout; Shop Drawings; EA

The Contractor shall submit to-scale drawings with plans, elevations, cross sections, and details as necessary to show the layout of the groundwater treatment system. The drawings shall show the layout and size of, but not be limited to, treatment equipment, tanks, piping, ductwork, controls, mechanical, electrical, instrumentation, utilities, sumps, and containment structures. The drawings shall show dimensions in sufficient detail to demonstrate that the treatment system will be sufficiently housed in the building, with adequate space to provide maintenance to the equipment, as specified in SECTION 13122 -GROUNDWATER TREATMENTBUILDING, and shall meet the requirements of the specifications.

After approval of design submittals and prior to initiation of construction, the Contractor shall submit for approval the following documents:

- Equipment shop drawings
- Flow and material balance diagram
- Control and instrument diagrams
- Control loops and logic diagrams
- Detailed piping drawings
- Detailed electrical drawings
- General arrangements and layout drawings

1.2.3 The Contractor shall submit an O&M Manual for the treatment system in accordance with SECTION 01850 - FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND START UP TRAINING.

1.2.4 The Contractor shall maintain and submit treatment system service records and reports during O&M in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATIONS AND MAINTENANCE.

1.2.5 Equipment Certificates; Certificates; FIO

Verification from a Registered Professional Engineer, licensed to practice mechanical or structural engineering in the State of New York, stating that: 1) The fabrication drawings and pressure calculations for the tank were designed for the listed conditions in accordance with the appropriate codes and standards; 2) The erection drawings for the tank and other equipment foundations and supports were designed for the listed conditions in accordance with the appropriate codes and standards.

1.2.6 Calculations; Design Data; EA

Provide calculations supporting the sizing for all equipment, piping, sumps, and containment structures.

1.2.7 Test Reports; Test Reports; EA

The Contractor shall submit shop and field test reports in booklet form showing the results of factory and field tests following the installation of the system. Each test report shall provide the final control and alarm settings.

1.2.8 Warranty; Certificates; FIO

The Contractor shall provide copies of equipment warranties for all equipment covered under this Section upon receipt of equipment. The equipment shall be warranted by the manufacturer for a period of one year, unless otherwise specified.

1.2.9 Hardware and Software Design; Design Data; EA

Shop drawings shall be submitted as detailed herein. They shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature will not be acceptable.

1.2.9.1 Field Instruments

Submit complete documentation of all field instruments using ISA-S20 data sheet formats.

1.2.9.2 Digital Equipment Hardware Submittal

1.2.9.2.1 Catalog cuts for Programmable Logic Controller (PLC), including central processing units, memory, input modules, output modules, modems, network interface modules, mounting racks, and power supplies. Submit system bill of materials and descriptive literature for each hardware component that fully describes the units being provided.

1.2.9.2.2 Catalog cuts for OIT and laptops, memory, printers, mass storage devices, modems, network interface modules, peripherals, and power supplies. Submit system bill of materials and descriptive literature for each hardware component, which fully describes the units being provided.

1.2.9.2.3 Complete system Input/Output (I/O) list for equipment connected to the control system under this Contract. The I/O list shall be submitted in Microsoft Excel readable electronic file format on a CD ROM and an 8-1/2 inch by 11-inch hard copy. The I/O list shall include I/O name (or spare), type, physical location, point address, functional description (text that includes signal source, control function, etc.), range (engineering units) and equivalent analog to digital "count" conversion, alarm limits (low-low, low, high, high-high, etc.), relay normal status contact configuration. The I/O list shall be sorted in order by

1) Physical location: Panel, Rack, CPU Name, or Remote I/O Drop

2) I/O Type: AI, AO, DI, DO, PI, PO, etc.

3) Loop Number

4) Device Tag

1.2.9.2.4 Complete block diagram showing the inter-connections between major hardware components, media type between components, raceway requirements (conduit, wireway, etc.), raceway identification, network protocol used at each network level, and all hardware components showing the interconnection of all modules, interface devices, modems, and plug-in circuit boards.

1.2.9.2.5 Calculations for controller program memory including additional memory requirements required over and above the memory available for process control applications. Scratch pad or "housekeeping" programs, additional overhead for programming formats, redundancy, etc. shall be fully included in the required total memory size calculation. Submit calculations verifying that the total memory provided will be adequate for the specified requirements.

1.2.9.2.6 Calculations for controller network speed indicating the probabilistic network throughput under the worse case loading conditions. Provide network statistical calculations showing that network throughput during periods of maximum system loading including the impact of the specified future expansion or 100% increase in the control system size whichever is greater. Calculations shall include verification of total time from issuing a command or query from the HMI and receiving positive feedback from the field level device of execution of the command during the specified high traffic period.

1.2.9.2.7 UPS and battery sizing calculations to verify compliance with the specified power usage and backup power duration requirements.

1.2.9.3 Software

1.2.9.3.1 Submit details of the controller, local operator interface terminal (OIT), and software application packages to be used for each piece of equipment. Indicate all standard and optional features provided. Include copies of license agreements indicating assignment of licenses to the EPA.

1.2.9.3.2 Submit program logic diagrams that present the overall program flow using standard Boolean and logic function symbols. Submit logic diagrams for complex loops only. Complex logic will include master control loops having multiple control and safety interlocks controlling systems equipment. Logic diagrams shall not be required for control of individual devices. Coordinate logic diagrams with the process & instrumentation (P&IDs), tagging systems, and process control strategies. Submit typical logic diagrams for identical process functions (e.g. parallel trains). When logic diagrams are developed, tag tables or other means of identifying the applicable specific process loop shall be used.

1.2.9.3.3 Submit software logic and documentation for ladder logic, function block, high level language or other controller language used for the application engineering effort. Each program module, subroutine, or function block shall be fully described in a program overview that defines the scanned inputs, scanned outputs, definition of constants and variables, and function of the routine.

1.2.9.3.4 Submit details of control system communication. Submit hardware and software configuration information in sufficient detail to verify performance of the communication system as detailed herein and on the Drawings. Include details of any necessary expansion boards, special interface requirements (e.g., cables, jacks, etc.), description of drivers and impact of drivers on controller memory configuration. Any specific communication block memory addresses shall be defined.

1.2.9.3.5 Submit a memory usage report for the controller. This report shall be in spreadsheet format and indicate both used and unused memory addresses. Include constant and variable memory assignment records that tabulates area, location, number, and description of each numeric constant or variable stored in memory.

1.2.9.3.6 Method and logic for special housekeeping programs and routines including redundancy, clock synchronization, value scaling, alarm handling, archiving, etc. Submit information for all digital systems including controllers, Local Control Panels (LCPs), and human-machine interface (HMI) equipment.

1.2.9.3.7 Submit cross reference index of I/O allocation, controller memory address, HMI or LCP graphic systems address, and HMI or LCP graphic screen where the I/O point will appear. Every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme shall be included.

1.2.9.3.8 Submit final drafts of logs, reports, and process graphic displays. The specifics of what shall appear on each display and report and what calculations are required to support them shall be described. Final drafts shall reflect the system requirements as specified herein as well as the result of the coordination meetings with the Engineer.

1.3 REFERENCES

Provide equipment that is designed, furnished, and erected in accordance with the rules, regulations, and standards of applicable regularity government and other stabilization societies including the following:

- AMERICAN PETROLEUM INSTITUTE (API)
- AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (AIEE)
- AMERICAN PUBLIC HEALTH ASSOCIATION (APHA)
- AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

- AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
- AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
- AMERICAN IRON AND STEEL INSTITUTE (AISI)
- AMERICAN WATER WORKS ASSOCIATION (AWWA)
- ENVIRONMENTAL PROTECTION AGENCY CONTRACT LABORATORY PROGRAM (EPA CLP)
- INSTRUMENTATION, SYSTEMS, AND AUTOMATION SOCIETY (ISA)
- INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)
- MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
- NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)
- NATIONAL ELECTRICAL COUNCIL (NEC)
- NATIONAL ELECTRICAL MANUFACTURES ASSOCIATION (NEMA)
- NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
- NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION (NJDEP)
- NEW JERSEY UNIFORM CONSTRUCTION CODE (NJUCC)
- OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)
- UNDERWRITERS LABORATORIES, INC. (UL)
- UNIFORM MECHANICAL CODE (UMC)
- UNIFORM PLUMBING CODE (UPC)

1.4 QUALITY ASSURANCE

The Contractor shall provide standard equipment modified as required and manufactured by companies whose products have commercially available replacement parts and have had similar units in service for not less than 5 years.

1.5 PERMITS

The Contractor shall be responsible for obtaining all necessary permits for the construction, operation, and maintenance of the treatment system and discharge of treated water in accordance with Federal, State and local regulatory requirements, with the exception of NYSPDES Permit Equivalent for Remediation Discharges to Surface water or Groundwater, which will be obtained by EPA.

1.6 SYSTEM DESCRIPTION

1.6.1 General

1.6.1.1 This Section describes the functions, configuration, and operating parameters of the system. It is intended to provide basic information necessary for the Contractor's design, selection of equipment, installation and operation of the system.

1.6.1.2 The minimum design flow rate for the treatment system shall be 150 gpm. However, the Contractor shall design a treatment system capable of continuously processing groundwater at a flow rate of up to 250 gpm to account for variability in the subsurface.

1.6.1.3 Estimated contaminant influent concentrations for the treatment system are summarized in Table 13300-1 of this specification.

1.6.1.4 Effluent shall be discharge to Nassau County recharge basin number 124 via a stormwater manhole as shown on the Contract Drawing. Treated groundwater shall meet the requirements defined in the NYSPDES permit equivalent. The estimated effluent target concentrations, as listed in Table 13300-1, are provided for the Contractor's reference.

1.6.1.5 Extraction well configurations are shown on the Contract Drawings. The extraction wells and pumps shall meet the requirements of SECTION 02525 - EXTRACTION WELL INSTALLATION AND TESTING and SECTION 11319 - SUBMERSIBLE WELL PUMPS, respectively.

1.6.1.6 At a minimum, the groundwater treatment system shall include the following processing units:

- An equalization tank to equalize the influent concentrations and flow.
- An air stripper to remove chlorinated VOCs from the extracted groundwater to meet the NYSPDES permit equivalent requirements for remediation discharge to surface or groundwaters.
- An optional iron removal system to treat iron from the influent stream to prevent fouling and scaling of the downstream air stripper and to meet NYSPDES discharge criteria. The Contractor shall propose the treatment process based on the actual iron concentration in the extracted groundwater, and pilot study results.
- An optional sludge handling system to manage the iron sludge generated from the iron treatment system. The Contractor shall propose the treatment process based on pilot study results.
- Chemical feed system(s) for pH adjustment and iron removal as necessary.

- Other components, such as transfer pumps, as required to ensure the functionality of the treatment systems and to meet the overall project objectives.

1.6.1.7 A P&ID is provided in the Contract Drawings as a baseline design with the greensand filters as the optional iron removal system. After groundwater extraction well installation, the Contractor shall collect groundwater samples during hydraulic testing and analyze for the representative actual influent water quality. If iron concentration is greater than the NYSPDES discharge criterion, the Contractor shall propose a pilot study and submit for the Engineer's approval. The pilot study shall be designed to evaluate the most appropriate iron removal technology for the site. Based on the influent concentrations from extraction wells and the pilot study results, the Contractor shall provide a complete and functional treatment system to meet the objectives of this specification.

1.6.2 Process Monitoring and Control

1.6.2.1 Instrumentation and controls shall be furnished for the treatment system to provide both automatic and manual operation of the system. The Contractor shall provide instrumentation to monitor process parameters including flow, pressure, pH, temperature, extraction well levels, and tank levels. Minimum instrument and control requirements are listed in Table 13300-2 of this specification, SECTION 13405 - PROCESS INSTRUMENTATION AND CONTROL PRODUCTS; SECTION 13410 - SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM; and the Contract Drawings.

1.6.2.2 System controls shall be completely automatic and capable of operation without a system operator present. Visual and audible alarms shall be provided to warn operators of abnormal conditions. A programmable logic controller (PLC) based control system shall be provided. Malfunction sensors shall be maintained at critical points in the treatment train to automatically provide a safe shutdown of the treatment and extraction systems in case of system upsets, loss of power, and emergency conditions including equipment failure.

1.6.2.3 Control of operation and shutdown shall be based on automated feedback loops on pressure, flow, pH, temperature, and tank levels.

1.6.3 Equipment/Process Layout

1.6.3.1 All equipment shall be located to provide minimum of 24-inch unobstructed access to portions requiring operation and maintenance. As a minimum, the working space requirements of Article 110, NFPA 70 (NEC) shall be maintained for all electrical equipment.

1.6.3.2 All piping shall be labeled with stream contents and arrows indicating the direction of the flow.

1.7 TOOLS AND SPARE PARTS

1.7.1 All special tools required for system normal operation and maintenance during the initial year of operation shall be furnished with the equipment.

1.7.2 The manufacturer shall provide a recommended spare parts list for each piece of moving equipment, with up-to date cost per item.

1.8 LINE SIZING CRITERIA

Line sizing criteria are listed in SECTION 15200 - PIPING, VALVES, AND APPURTENANCES.

1.9 DELIVERY, STORAGE, AND HANDLING

1.9.1 The Contractor shall arrange for the freight to the site and for on- and off-loading of all system equipment shipped to the site.

1.9.2 To the extent possible, all equipment shall be delivered on transportable structural steel skids to the site, pre-piped and pre-wired, and ready for hookup.

1.9.3 Exact delivery data/time of each subsystem shall be confirmed to the Engineer at least 2 working days prior to delivery.

1.9.4 The equipment shall be shipped, delivered, handled, stored, and installed in ways that will prevent damage to the items.

1.9.5 The equipment shall be shipped with suitable in-transit protection and shall be outfitted with lifting lugs, cleats, or other suitable means for unloading and erecting.

1.9.6 Finish surfaces shall be protected against impact, discoloration, and other damage by removable tape or suitable protective coating. Finished surfaces of flanges shall be protected by wooden or plastic blind flanges. Hex-head plugs shall be placed on all threaded female connection.

1.9.7 Grease and lubricating oil shall be applied to all bearings and similar items prior to shipping. One quart of lubricating oil and one tube of grease used in equipment shall accompany shipment.

1.9.8 After hydrostatic or other tests during fabrication, all entrapped water shall be drained, and care shall be taken to prevent the entrance of water or dirt during shipment, storage and handling.

1.10 REGULATIONS AND CODES

The Contractor shall comply with all the laws, ordinances, codes, rules, and regulations of the Federal, State, and local authorities having jurisdiction over any of the work specified herein.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT - GENERAL

2.1.1 The Contractor shall furnish and install a complete system ready for operation.

2.1.2 Parts shall be amply portioned for stress, which may occur during fabrication, transportation, unloading, erection, and operation. All units and/or parts of the same size shall be identical and interchangeable. Contractor shall be responsible for all structural, mechanical, instrumentation, process and electrical design, as well as assembly and related work.

2.1.3 Each unit shall be constructed of corrosion-resistant material and suitable for the service noted.

2.1.4 All wetted parts that will come in contact with groundwater shall be suitable for the intended purpose and shall not cause swelling because of the presence of VOCs.

2.1.5 All units shall be located inside the treatment facility building.

2.1.6 The tanks shall be supplied with a steel platform complete with ladder, handrail, and toe plates in compliance with OSHA and UBC standards. Equipment is not expected to be higher than 15 feet. If taller equipment is deemed necessary by the Contractor and is approved by the Engineer, a cage shall be included if the ladder exceeds 20 feet.

2.1.7 The tank construction material shall be compatible with the material stored. Tanks constructed of polyethylene, polypropylene, and fiberglass reinforced plastic shall conform to applicable material and construction provisions of ASTM C 582, ASTM D 3299, and ASTM D 4097. Steel tanks shall conform to AWWA D 100. Carbon steel tank shall be ASTM A 283/A 283M carbon steel Grade C or D and shall be protected with an interior coating appropriate for the intended service in accordance with the manufacturer's written instruction. Exterior painting shall be performed in accordance with the manufacturer's instructions.

2.2 GROUNDWATER TREATMENT SYSTEM EQUIPMENT

The performance objective for the treatment system is to meet the required effluent standards as specified in NYSPDES permit equivalent. The Contractor shall provide a treatment system based on the actual influent water quality and pilot testing results if conducted. The following specifications apply only if the contractor's treatment system requires the specific component.

2.2.1 Equalization Tank (T-1)

2.2.1.1 The equalization tank (T-1) shall be fabricated offsite and ready for connection of external piping, vents, and pumps.

2.2.1.2 The tank shall be flat bottom and sized with usable volume to provide a minimum of 10 minutes of storage/detention time based upon an assumed maximum flow rate of 250 gpm. The tank shall also be sized to accommodate the backwash wastewater from the iron removal system, if necessary, and provide a constant flow to the subsequent treatment system. The bottom one foot and six inches below the bottom of the overflow nozzle of the tank shall not be included as an effective volume of the tank.

2.2.1.3 Tanks shall be provided with fittings appropriate for the size and materials of connecting pipes. The tank shall be provided with fittings for all pipe penetration and instrumentation. As a minimum, the tank shall be fitted, on top of the tank, with a 24-inch top manhole, influent and effluent connections, vent connection, overflow connection, a spare 6-inch connection, sump inlet connection, fittings for water level sensors, and other connections as needed, as shown on the Contract Drawings. The spare 6-inch connection shall have flange ends on both inside and outside of the tank, provided with blind flange on the outside end. The effluent connection and the drain connection shall be at the side, as close to the bottom of the tank as possible. The tank shall also be provided with a 6-inch overflow and shall drain to building sump. Pipe and instrumentation connection fittings provided should be appropriate for the service, pipe size, and pipe material.

2.2.1.4 The tank shall have provisions for reducing exposure of water to air by extending the inlet pipe to within one foot from the bottom of the tank (drop tube). The drop tube shall be properly supported. A 90-degree elbow and an eductor shall be fitted to the end of the inlet pipe to facilitate accelerated mixing of the stored water and to prevent settling of sediment.

2.2.1.5 The Contractor shall have provisions to allow for accurate water level measurements while the water is being mixed.

2.2.1.6 The tank shall have a closed top with a vent equipped with a pressure/vacuum relief valve. The pressure relief portion of the valve shall be connected to a vent header discharging to the roof stack.

2.2.2 Chemical Feed System

2.2.2.1 Chemical feed systems shall consist of chemical storage tanks from which the chemical solution shall be pumped through piping to the point of application. Separate chemical feed systems shall be provided for each chemical. Each chemical feed system may be supplied as a complete package with instrumentation and control for automated operation; and shall include metering pumps, gauges, back pressure regulators, strainers as necessary, pulsation dampers, adjustable pressure relief valves, flow measuring devices, check valves, and manual valves.

2.2.2.2 Caustic solution (sodium hydroxide) shall be used to raise the pH value to a minimum of 6.5 to meet the NYSPDES permit equivalent requirement or to the appropriate pH required by iron removal system (optional work). The Contractor shall submit to the Engineer for approval the alternative to caustic solution to raise the pH prior to its use. Chemicals to be used for iron removal system (optional work) are listed under Section 2.2.7.

2.2.2.3 The Contractor shall optimize chemical usage to reduce O&M costs.

2.2.2.4 The chemical feed system shall be a standard product of a manufacturer regularly engaged in the manufacture of such products.

2.2.2.5 The metering pumps shall be sized to deliver chemical solution at any rate from the minimum flow to 150% of the required flow. Positive displacement electronic pulsed metering pumps are recommended. The stroke length shall be manually adjustable, 0 to 100 percent capacity control while pump in motion. Pump delivery shall be repeatable within plus or minus 1 percent accuracy over a 10:1 range for stroke frequency and 5:1 range for stroke length.

2.2.2.6 The metering pumps shall be dry-lift, self-priming and capable of indefinite operation without process fluid.

2.2.2.7 All wetted materials shall be suitable for the intended chemical use.

2.2.2.8 Each chemical feed system shall be provided with local control panel as well as contacts for remote control from the main control room.

2.2.2.9 Each chemical storage tank shall be equipped with fill nozzle, vent, sight glass, discharge, drain, and access at the top for cleaning purpose, two spare connections, and other connections as necessary. Each storage tank shall have individual secondary containment that meets RCRA requirements. Combination of secondary containment area shall be submitted for Engineer's approval.

2.2.2.10 The caustic storage tank shall be sized to accept one truck load of chemical, plus additional tank volume to add dilution water as necessary. The caustic will be delivered in 50% concentration. A storage capacity of one month or more is desirable.

2.2.2.11 Unbreakable sight glasses shall be provided for the chemical storage tanks.

2.2.2.12 The Contractor shall furnish an in-line static mixer for continuous, instantaneous flash mixing of chemicals in the pipeline, if it cannot be mixed in a tank.

2.2.2.13 All materials used in contact with the chemical solutions shall be fully resistant to the solutions.

2.2.3 Bag Filters (BF-1 and BF-2)

2.2.3.1 The Contractor shall furnish a duplex bag filtration system to remove suspended solids and protect the air stripper. The bag filtration system shall be pre-piped with isolation valves in the factory and ready for installation in the field.

2.2.3.2 The bag filters will be operated in parallel, with one filter online and the second filter on standby. Each bag filter shall be capable of accepting flow rates up to 250 gpm.

2.2.3.3 A differential pressure indication and alarm shall be provided on the main control panel in the control room to signal the need for bag change-out.

2.2.3.4 Drain and vent valves shall be provided to release the pressure within the filter vessel prior to opening of the lid. A pressure gauge shall be provided at the lid to indicate the pressure inside the filter.

2.2.3.5 The filter bag opening shall be sized to prevent suspended solids from entering the air stripper. The filter bag shall be sized to have enough capacity such that bag replacement shall not be required more than once per week.

2.2.4 Air Stripper Unit

2.2.4.1 The Contractor shall furnish a low-profile air stripper unit to serve as the primary treatment of the contaminated groundwater. The air stripper system shall be capable of reducing VOC concentrations in groundwater to meet the NYSPDES permit equivalent discharge requirements.

2.2.4.2 Water shall enter the air stripper unit at the top and flow downward through trays for treatment. The treated water shall accumulate in the air stripper sump and shall be pumped through the effluent piping to the recharge basin. Water level switch shall be equipped in the sump to be integrated with the control of discharge pump P-2.

2.2.4.3 The air stripper unit shall be sized to treat continuously a groundwater flow range from 150 to 300 gpm.

2.2.4.4 The unit and internal materials of construction shall be corrosion resistant.

2.2.4.5 The air stripper unit shall be furnished complete with blower, internal trays, piping, valves, fittings, and controls.

2.2.4.6 Induced draft mode operation of the blower is preferred to utilize the waste heat from the blower to elevate the temperature of the off-gas air stream and reduce its relative humidity.

2.2.4.7 Each tray shall be easily slid (or taken) out for maintenance. Lifting handles shall be provided on both ends.

2.2.4.8 Off-gas from air stripper shall be discharged above the building roof stack.

2.2.4.9 The air blower (B-1) shall be sized for 100 percent rated capacity to provide air at the volume and static pressure required by the system to produce the required performance. The blower shall operate by withdrawing ambient air.

2.2.4.10 The air blower shall be heavy duty centrifugal type, with statically balanced impeller, permanently lubricated motor bearing, and neoprene vibration isolators at metal contacts.

2.2.4.11 The air blower shall be capable of delivering air at a static pressure required to overcome maximum pressure drop across the air stripper and off gas treatment system.

2.2.4.12 Blower parts that come in contact with the air stream shall be constructed of corrosion-resistance materials.

2.2.4.13 The blower shall meet the requirements of OSHA Safety and Health Standards Subpart G 1910.95, Occupational Noise Exposure, and shall be sufficiently quite to allow safe operation.

2.2.4.14 An air flow meter, temperature gauge, and static pressure gage shall be furnished on the blower discharge duct. Sound dampening insulation shall be provided around the blower and motor for quiet operation. An air filter and insect/bird screen shall be provided on the inlet air supply duct to the blower.

2.2.4.15 The air stripper shall be equipped with a separate acid re-circulation line and pump that will enable maintenance of the air stripper when necessary. The pump shall be corrosion resistant and shall be a standard product of a manufacturer regularly engaged in the manufacture of such product. The acid shall enter the air stripper at the top and flow downward through the trays. The acid shall accumulate in the air stripper sump and shall be re-circulated backed to the top of the air stripper.

2.2.4.16 The Contractor shall be responsible for appropriate collection, storage, usage, and disposal of acid. The Contractor shall be responsible for supplying the acid as needed. The type and concentration of acid, and storage, usage and disposal procedures shall be included in the

Contractors O&M manual. Secondary containment for storage of acid shall be provided. The acid shall be not allowed to discharge to the effluent injection wells.

2.2.5 Sump Pump (SMP-1)

2.2.5.1 Sump pump and sump shall be installed at a low point in the Groundwater Treatment Building for spill control.

2.2.5.2 The pump shall be an automatic submersible pump with an integral float switch. Another float switch shall be installed to provide a high-high level alarm to the main control panel.

2.2.5.3 The parts of the sump pump exposed to fluid shall be made of materials compatible with the service indicated. Motor shafts shall be completely sealed from the fluids being pumped.

2.2.5.4 The motor for each sump pump shall be in accordance with those parts of the NEMA motor standards that are applicable for the type of motor and service conditions involved. The motor shall be sized for the horsepower required at any flow on the performance curve.

2.2.5.5 Water from the sump collection system shall be discharged into the equalization tank, as shown on the Contract Drawings.

2.2.6 Process Pumps (P-1 and P-2)

2.2.6.1 Centrifugal pumps shall be provided as required for fluid transfer within the groundwater treatment system as shown on the Contract Drawings and described herein.

2.2.6.2 The design flow rate for process pumps P-1 and P-2 ranges from 150 gpm to 300 gpm or otherwise approved by the Engineer.

2.2.6.3 Centrifugal pumps of horizontal, ANSI type, single stage, end suction water pumps coupled to an electric motor by means of a spacer type coupling with coupling guard.

2.2.6.4 Pumps shall be mounted on a rigid structural steel skid on top of a concrete pad.

2.2.6.5 Pump materials of construction shall be compatible with the pumped fluid and be corrosion-resistant. Pumps shall be capable of pumping the required flow rate at the required head conditions, and shall be capable of providing sufficient outlet pressure at the effluent flange.

2.2.6.6 Variable speed drive shall be provided for the transfer pumps (P-1 and P-2) to maintain constant water levels inside the equalization tank and the air stripper sump.

2.2.6.7 Additional Requirements:

2.2.6.7.1 Casing shall be one piece with a side cover. The casing shall be designed to permit replacement of wearing parts. The type used shall be that which is the most desirable for the fluid handled, the pressure differential across the leakage joint, the surface speed, and the particular pump design. Provide minimum ½ inch plugged drains and vents on pump casing.

2.2.6.7.2 The impeller shall be of the type designed for the specific application.

2.2.6.7.3 The shaft shall be one-piece construction, machined and ground, and have sleeves securely locked in place. The shaft shall be larger than required to transmit maximum torque. The shaft diameter shall be such that deflection shall not exceed 0.006 inch.

2.2.6.7.4 Single face replaceable mechanical seals rated for the temperature, pressure, and water quality to be pumped in the system shall be provided. Seals shall prevent leakage of air into the pump, or leakage of water out of the pump.

2.2.6.7.5 Couplings shall be flexible (vibration isolation) arch type couplings, properly restrained with control rods, suitable for use with the contaminants. Where lubrication is required, necessary fittings and seals shall be included. Moving parts within reach of operating personnel shall be covered with easily removable, freestanding guards meeting OSHA rules and regulations.

2.2.6.7.6 Motor shall be continuous duty electric totally enclosed fan cooled (TEFC) squirrel-cage induction type. Motor shall be sized so that when operating at rated speed, motor cannot be overload despite variation in pumping head.

2.2.6.7.7 Pump(s) suction and discharge shall be provided with flanged connections of suitable size. Piping shall be installed to preclude the formation of air pocket.

2.2.6.7.8 Bearing shall be the manufacturer's standard ball or roller type suitable for the service intended. Bearing shall be oil or grease lubricated and provided with all necessary piping and fittings for lubrication and/or cooling.

2.2.7 Optional Item - Iron Removal System

2.2.7.1 General

2.2.7.1.1 The iron removal system shall be sized to treat continuously a groundwater flow range from 200 gpm to 250 gpm to meet the NYSPDES discharge criteria.

2.2.7.1.2 The iron removal system shall be design and fabricated to meet site-specific constrains, such as to fit in the treatment building as specified in Section 13122 – GROUNDWATER TREATMENT BUILDING.

2.2.7.2 Greensand filtration system

2.2.7.2.1 Greensand filtration system are used as the representative iron removal system and specified herein.

2.2.7.2.2 The greensand filtration system shall be specifically designed for this project. It shall consist of pressure filtration units and related piping, manual and automatic valves, control system, and any others as necessary for a complete and functioning system.

2.2.7.2.3 The greensand filtration system shall be provided as a skid mounted system with automated operation controls and shall be capable of integrating into the overall plant control system.

2.2.7.2.4 The system shall consist of more than one pressure filter for continuous operation. When one filter is under backwash mood, the remaining filter or filters shall have the capability to treat the maximum flow.

2.2.7.2.5 The greensand filtration system shall be a fully automatic system with continuous filter media regeneration and interlocks between the filters to prevent more than one filter backwashing at once.

2.2.7.2.6 Backwashing shall be initiated manually or by a time clock setting on the control panel. The timer shall allow sequential backwashing of the filters based on an adjustable lapsed time. It shall also allow for an adjustable time delay between successive backwashes in the sequence. The backwash and rinse rates shall be set manually and controlled by an automatic control valve on the discharge piping. The backwash system logic shall provide dry contact closures to activate the rate controller, and initiate backwash and rinse flow rates. Backwash flow rate shall be 12 to 15 gpm/sq ft and rinse flow rate shall be 2 to 3 gpm/sq ft. The control shall include the ability to accept remote signals to initiate a backwash cycle, or to prevent initiation of backwashing by the timer.

2.2.7.2.7 The greensand filter tanks shall be of welded steel construction using SA 516 Grade 70 steel, rated for a design working pressure of 100 psi and tested in accordance with the latest ASME Code standards so as to bear an ASME Code stamp.

2.2.7.2.8 Tanks shall include top access manway and side access manway. Tanks shall at a minimum have the following tappings: an inlet/backwash discharge located at the center of the top head; an outlet/backwash inlet located on the side; an air release valve tap on the top head.

2.2.7.2.9 Each filter shall be furnished with a hub lateral type inlet distributor/backwash collector system designed with Schedule 80 PVC pipe and fittings. The distributing system shall be designed for uniform distribution of inlet water over the entire filter bed, and for the uniform collection of the backwash water during the backwash operation.

2.2.7.2.10 Each filter tank shall be furnished with a header lateral underdrain system designed to uniformly distribute backwash water and for collection of filtered water.

2.2.7.2.11 A gravel support bed shall be incorporated in the bottom of each greensand filter vessel, consisting of multiple layers of graded gravel, with the largest size gravel loaded into the filter first and the succeeding smaller sizes placed on top. The gravel can be field installed by the greensand filtration system manufacturer.

2.2.7.2.12 Each filter shall be designed to be in service for a minimum of 24 hour before backwash, unless otherwise approved by the Engineer. All filter media is to be field installed by the greensand filtration system manufacturer.

2.2.7.2.13 Each filter shall be furnished with automatic and manual valves for influent, effluent, backwash inlet, backwash outlet, and rinse outlet. Automatic valves and motor operators shall be as specified in SECTION 15200 - PIPING, VALVE, AND APPURTENANCES.

2.2.7.2.14 All piping and fittings shall be of the materials compatible with material they service.

2.2.7.3 Sludge Settling Tank (T-3)

2.2.7.3.1 The sludge settling tank (T-3) shall be fabricated offsite and ready for connection of external piping, vents, and pumps.

2.2.7.3.2 The tank shall be sized (usable volume between low and high level switches settings) to hold 150% of backwash water from backwash of one greensand filter plus temporary storage of settled sludge as necessary; or shall be sized as appropriate for other iron removal system.

2.2.7.3.3 The tank shall have a cone bottom to facilitate sludge removal.

2.2.7.3.4 The tank shall be provided with fittings appropriate for the size and materials of connecting pipes. The tank shall be provided with fittings for all pipe penetration and instrumentation. As a minimum, the tank shall be fitted, on top of the tank, with a 24-inch top manhole, influent connection, vent connection, fittings for water level sensors, and other connections as needed. The effluent connection for supernatant shall be at the side wall and above the sludge storage volume. Baffles may be designed to minimize disturbance of sludge during pumping of supernatant. The drain shall be at the bottom of the tank. The tank shall also be provided with a 6-inch overflow and shall drain to building sump. Pipe and instrumentation connection fittings provided should be appropriate for the service, pipe size, and pipe material.

2.2.7.3.5 The tank shall have a closed top with a vent equipped with a pressure/vacuum relief valve. The pressure relief portion of the valve shall be connected to a vent header discharging to the roof stack.

2.2.7.3.6 Inlet baffle shall be provided to minimize disturbance of sludge in the tank.

2.2.7.4 Sludge Holding Tank (T-4)

2.2.7.4.1 The sludge holding Tank (T-4) shall be fabricated offsite and ready for connection of external piping, vents, and pumps.

2.2.7.4.2 The tank shall be adequately sized to hold sludge for a minimum of one week. The tank shall have a closed top.

2.2.7.4.3 The tank shall have a cone bottom to facilitate sludge removal.

2.2.7.4.4 Tanks shall be provided with fittings appropriate for the size and materials of the pipe. The tank shall be provided with fittings for all pipe penetration and instrumentation. At a minimum, the tank shall be fitted, on top of the tank, with an influent connection, a 24-inch top manhole, fittings for water level sensor, vent connection, one spare 4-inch connection, one connection for the mixer (if required), and other connections as needed. The spare 4-inch connection shall have flange ends provided with blind flange. The effluent and drain connection shall be at the bottom of the tank. The tank shall also be provided with a 6-inch overflow half foot from the top ridge of the side wall and shall drain to building sump. Pipe and instrumentation connection fittings provided should be appropriate for the service, pipe size, and pipe material.

2.2.7.4.5 The tank shall have a closed top with a vent equipped with a pressure/vacuum relief valve. The pressure relief portion of the valve shall be connected to a vent header to the building roof.

2.2.7.5 Clean Water Tank (T-7)

2.2.7.5.1 The clean water tank shall be provided to store treated water for greensand filter backwash. The tank shall be sized to hold, at a minimum, the required volume of water for backwash of one greensand filter.

2.2.7.5.2 Tank shall be provided with fittings appropriate for the size and materials of the pipe. The tank shall be provided with fittings for all pipe penetration and instrumentation. At a minimum, the tank shall be fitted, with a 24-inch top manhole, influent and effluent connection, fittings for water level sensor, vent connection, one spare 4-inch connection, and other connections as needed. The spare 4-inch connection shall have flange ends provided with blind flange. The effluent and drain connection shall be at the bottom of the cone. The tank shall also be provided with a 6-inch overflow half foot from the top ridge of the side wall and shall drain to building sump. Pipe and instrumentation connection fittings provided should be appropriate for the service, pipe size, and pipe material.

2.2.7.6 Process Pump (P-3 and P-5)

2.2.7.6.1 Centrifugal pumps shall be provided to transfer supernatant in sludge settling tank (T-3) and treated water in effluent tank (T-7) as shown on the Contract Drawings and described herein.

2.2.7.6.2 The pump shall be designed to handle the required flow as determined by the Contractor and approved by the Engineer. Operation of the transfer pump shall be automatically controlled by the PLC.

2.2.7.6.3 Centrifugal pump shall be horizontal, ANSI type, single stage, end suction water pumps coupled to an electric motor by means of a spacer type coupling with coupling guard.

2.2.7.6.4 Pumps shall be mounted on a rigid structural steel skid on top of concrete pads.

2.2.7.6.5 Pump materials of construction shall be compatible with the pumped fluid and be corrosion-resistant.

2.2.7.6.6 Additional requirements for centrifugal pumps shall meet the requirements of Paragraph 2.2.6.7.

2.2.7.7 Sludge Pump (P-4)

2.2.7.7.1 The sludge pump shall be constructed suitable to transfer the iron sludge.

2.2.7.7.2 The sludge pump shall be designed to handle the required flow.

2.2.7.7.3 The sludge pump shall be capable of manual or automatic operation.

2.2.7.7.4 Positive displacement, single stage, progressive cavity type pump is recommended.

2.2.7.7.4.1 The pump drive shall consist of a constant speed motor which shall be connected to the pump shaft through V-belts.

2.2.7.7.4.2 The pump body shall be of thick walled cast iron and shall incorporate two inspection ports 180 degrees apart. The pump shall be cradle mounted to permit the suction port to be rotated to any angle perpendicular to the centerline of the pump.

2.2.7.7.4.3 The pump rotor shall be machined of high carbon tool steel, hardened to a Rockwell "C" value of 57 to 60 and covered with a heavy layer of hard chrome plate at least 0.01 in thick for abrasion resistance.

2.2.7.7.4.4 The rotor shall rotate relative to a one piece, EPDM rubber stator of approximate 65 Durometer hardness (Shore A) chemically bonded to its steel tube housing. The stator shall be arranged to prevent the pumped material from contacting the bonding or the tube.

2.2.7.7.4.5 The rotor shall be joined to the drive shaft by a carbon steel connecting rod and crowned gear type, grease lubricated, sealed universal joints of chrome alloy tool steel of adequate design to transmit the required thrust and torque while allowing the rotor to move through is eccentric path. The gear joint seals shall be clamped at both outside and inside diameters and recessed within heavy walled steel tubing to prevent damage by rags or other objects.

2.2.7.7.4.6 To maximize universal joint and seal life, the connecting rod operating angle shall not exceed 1 1/4 degrees off center. To minimize the moment of the transmitted radial force on the bearings and to minimize overall pump length, the connecting rod shall telescope within a hollow drive shaft and shall be attached to the drive shaft in close proximity to the bearings. This point of attachment shall not be more distant from the nearest bearing than the spacing between the two bearings. This method of drive shall minimize the shaft deflection in the stuffing box area.

2.2.7.7.4.7 The drive shaft shall be mounted in two ball or tapered roller bearings. The life expectancy of the bearings shall be in excess of 100,000 hours at the maximum operating conditions. Fittings shall be provided for grease lubrication of the bearings.

2.2.7.7.4.8 The stuffing box shall be equipped with a ductile iron gland, split Teflon lantern ring to permit repacking of the pump without removing the bearings or drive shaft components. Fittings shall be provided for grease lubrication of the packing.

2.2.7.7.4.9 The motor shall be horizontal, totally enclosed, fan cooled, foot mounted, NEMA Design B.

2.2.7.7.4.10 The motor, drive and pump shall be mounted on a common base of welded steel or cast iron.

2.2.7.8 Chemical Feed System(s)

Chemical feed systems for sodium hypochlorite and ferric chloride solutions shall meet the requirements of Paragraph 2.2.2. Sodium hypochlorite solution shall be used continuously to regenerate the greensand media. Ferric chloride solution shall be used as a coagulant with the greensand filter backwash wastewater to aid the solid settlement in the sludge holding tank.

The Contractor shall submit to the Engineer for approval the alternative to sodium hypochlorite or ferric chloride solutions prior to its use.

2.2.8 In-line Static Mixer

2.2.8.1 In-line static mixer shall be provided for the purpose of flash mixing chemicals into the raw water.

2.2.8.2 The static mixer shall of the continuous mixing design wherein the elemental geometry divides and rotates the influent flow while approaching a plug flow condition. The static mixer configuration shall consist of full elements which rotate the flow radially in opposing directions as the flow moves axially through the mixer and shall provide complete mixing at design conditions.

2.2.8.3 The minimum cross-sectional flow area of the static mixer shall be at least 98 percent of the open pipe area to avoid obstruction of flow and plugging.

2.2.8.4 The mixer can be constructed of PVC.

2.2.8.5 The mixer housing shall be designed to withstand the operating pressure. The housing shall have end connections that are integrally molded with the body of the mixer.

2.2.8.6 The average variation of chemical concentration in the feed water, 10 pipe diameters downstream of the static mixer shall be within one percent.

2.2.8.7 Manufacturer shall provide injection quill that have built in check valve for chemical process connection.

2.2.9 System Piping, Valves and Fittings

2.2.9.1 The Contractor shall furnish all piping, valves and fittings in accordance with SECTION 15200 - PIPING, VALVES, AND APPURTENANCES for a complete operational groundwater treatment system. All system piping shall be installed in place with all supports and tie-downs for a complete package.

2.2.9.2 All piping, valves and fittings shall be glued, threaded, or flanged for liquid carrying lines. Manual valves on lines 3 inches and smaller shall be full port ball valves. Manual valves on lines greater than 3 inches shall be butterfly valves unless specified on the Contract Drawings. Full port plug valves shall be used for lines handling sludge. Provide removable unions or ANSI flanges on both sides of all equipment, valves and instruments to allow for ease in replacement without cutting the pipe.

PART 3 EXECUTION

3.1 SURFACE PREPARATION AND COATING

3.1.1 Preparation and coating shall be manufacturer's standard finish for the installation and service described.

3.1.2 All surface preparation and coating shall take place at the place of fabrication, with only field touch up required.

3.2 INSTALLATION AND ERECTION

3.2.1 All component equipment when possible shall be furnished, skid mounted, pre-piped and pre-wired ready for hookup. The installation of the system equipment shall be in strict accordance with the manufacturer's technical data and printed instructions. Anchor bolts, guy wires, and supporting incidentals shall be furnished as required for proper installation of each component. If required to distribute weight, ship carbon media and/or vessels separately for field installation.

3.2.2 All equipment shall be installed in accordance with the instructions of the manufacturer, and in accordance with SECTION 13122 - GROUNDWATER TREATMENT BUILDING. The Contractor shall apply lubricating fluids and greases according to manufacturer's recommendations. The Contractor shall be responsible for all start-up checks and adjustments and shall perform them in accordance with all manufacturers' requirements.

3.2.3 Tanks shall be installed in accordance with the manufacturers provided instructions. Tank mounting and tie down devices shall be provided as recommended by manufacturer.

3.2.4 Equipment pads shall be provided for system equipment as required. Equipment pads shall be constructed in accordance with DIVISION 3 - CONCRETE specifications.

3.3 TESTING

3.3.1 All components of process, mechanical, and electrical equipment, including related piping and control systems, shall be tested by the Contractor in accordance with the requirements of SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE, SECTION 13405 - PROCESS INSTRUMENTATION AND CONTROL PRODUCTS, SECTION 13410 - SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM, AND SECTION 15200 - PIPING, VALVES, AND APPURTENANCES.

3.3.2 Testing of tanks shall be in accordance with ASTM and AWWA standards.

3.4 OPERATION AND MAINTENANCE

Operation and maintenance requirements shall be performed in accordance with SECTION 01800 - TREATMENT SYSTEM OPERATIONS AND MAINTENANCE and the approved O&M Manual.

3.5 SAMPLING AND ANALYSIS

Sampling and analysis requirements are listed in SECTION 01450 - CHEMICAL DATA QUALITY CONTROL, SECTION 02525 - WELL INSTALLATION AND TESTING and SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENENACE.

3.6 DISPOSAL OF RESIDUES

All construction and process-derived wastes, including but not limited to, construction and demolition debris, surplus soils from trenching, backwash sediments, and personal protective equipment (PPE) shall be disposed in accordance with SECTION 02120 - OFFSITE TRANSPORTATION AND DISPOSAL.

END OF SECTION

Table 13300-1
Influent Concentrations and Effluent Targets

Parameters	Units	Influent Water Quality [1]	Effluent Targets[2]
Flow Rate:	gpm	200	NA
pH [3]	unit	5.0	6.5 - 8.5
Target VOCs:			
cis-1,2-Dichloroethene	µg/L	8.1	5
Dichlorodifluoromethane	µg/L	7.7	5
Tetrachloroethene	µg/L	53.1	1
Trichloroethene	µg/L	139.7	5
Target Metals: [4]			
Iron	mg/L	3.6	0.3
Manganese	mg/L	0.2	0.3

Notes:

1. Average influent water quality estimates based on weighted averages of well concentrations within the capture zone.
2. Effluent targets were determined using the lowest values between Federal Drinking Water and New York State Ambient Water Quality Standards and Guidance Values for Class GA Groundwater and Class C Surface Water.
   Final effluent criteria will be determined in accordance with the New York State Pollution Discharge Elimination System (NYSPDES) permit equivalency.
3. The average influent pH of two Garden City supply wells is used.
4. Iron treatment is to meet the NYSPDES permit requirements and for scaling and fouling protection of the treatment system.

ug/L - micrograms per liter
mg/L - milligrams per liter
gpm - gallon per minute
NA - not applicable

Table 13300 - 2
Process Instrumentation and Controls Description

					Alarms				
		PLC	PLC		Indication		Shutdown		
Equipment	Condition	Input	Output(1)	Hardwired Interlock	OIT Display	Auto-Dialer	Equipment	System(2)	Comments
PLC System									
PLC	Power failure	X			X	X		X	Signal is sent directly to the auto-dialer in addition to the PLC.
PLC	Processor fault		X			X		X	
Emergency Stop Station	Emergency stop	X	X	X	X	X		X	As activated by system operator.
Groundwater Pumping System:									
Well Pumps EW-1S, EW-1I, EW-1D	Pump in hand mode				X				Manual pump operation through the local hand switch.
Well Pumps EW-1S, EW-1I, EW-1D	Pump in automatic mode	X			X				Enables automated pump operation by PLC.
Well Pumps EW-1S, EW-1I, EW-1D	Pump general overload or fault (3)	X	X	X	X	X	Well pumps		General fault condition from pump status box to PLC and from the PLC to the autodialer. Stops the well pump.
Well Pumps EW-1S, EW-1I, EW-1D	Pump running	X			X				Pump on/off status to PLC
Well Pumps EW-1S, EW-1I, EW-1D	Flow indicating transmitter	X	X		X				Flow rate data to PLC, used by PLC to adjust the globe valve for flow control
Motorized globe valve	valve open position	X	X		X				Percentage opening of the valve
Level Transducers	Low level	X	X	X	X	X	Well pumps		Stops the respective well pump.
Influent Header in Well Vault	High pressure	X	X		X	X	Well pumps		Stops the well pumps. Time delay to avoid false trips.
Influent Header at the Plant	Flow indicating transmitter	X			X				Monitor groundwater flow rate into the treatment plant,
Equalization tank (T-1):									
Equalization Tank	High high level	X	X	X	X	X	Well pumps		Stops well pumps and sends alarm.
Equalization Tank	Low low level	X	X	X	X	X	Transfer pump P-1		Stops transfer pump P-1.
Equalization Tank	Level Indicating transmitter	X			X				Used as process variable in determining pumping rate
Equalization Tank (with greensand filters)	Level Indicate transmitter	X	X		X				Used as process variable in determining pumping rate. See note 7.

Table 13300 - 2

Process Instrumentation and Controls Description

Equipment	Condition	PLC Input	PLC Output[1]	Hardwired Interlock	Alarms: Indication: OIT Display	Alarms: Indication: Auto-Dialer	Alarms: Shutdown: Equipment	Alarms: Shutdown: System[2]	Comments
Equalization Tank	Low level	X	X		X	X			Send alarm to operator, the operator shall investigate the cause.
Equalization Tank	High level	X	X		X	X			Send alarm to operator, the operator shall investigate the cause. Supernatant transfer pump P-3 can not start
Equalization Tank	pH analyzing transmitter	X			X				Record pH in equalization tank and used as process variable to determine caustic feed
Transfer pump (P-1) [4]									
Transfer Pump P-1	Pump in automatic mode	X			X				Enables automated pump operation by PLC, variable speed based on tank levels.
Transfer Pump P-1	Pump in hand mode				X				Initiates manual pump operation
Transfer Pump P-1	Pump running	X			X				On/off status to PLC
Transfer Pump P-1	Pump failure	X	X		X	X	Pump P-1	X	Shut down pump P-1
Transfer Pump P-1	VFD fault	X	X		X	X	Pump P-1	X	Shut down pump P-1
Transfer Pump P-1	Speed	X			X				Indication of pump speed.
Transfer Pump P-1	Speed reference		X		X				Speed reference signal sent to VFD from PLC.
Bag filters									
Bag Filters	Differential pressure high	X	X		X	X		X	Notifies operator to change bag filter.
Air Stripper System and Transfer Pump (P-2)[4]:									
Blower B-1	Vacumm switch high	X	X	X	X	X		X	Indicating air flow blocked, shut down transfer pump P-1, and the system
Blower B-1	Timed delay during start/stop	X	X	X					Blower B-1 must be on before the well pumps and P-1 are on; Delay shut down of blower after shut down of well pump and P-1.

Table 13300 - 2
Process Instrumentation and Controls Description

Equipment	Condition	PLC Input	PLC Output[1]	Hardwired Interlock	Alarms: Indication: OIT Display	Alarms: Indication: Auto-Dialer	Alarms: Shutdown: Equipment	Alarms: Shutdown: System[2]	Comments
Blower B-1	Delay re-start of blower after stop	X	X						Allow blower to reach a complete stop before re-start.
Blower B-1	Failure	X	X		X	X		X	Any blower failure the system shall be shut down
Blower B-1	Blower running	X			X				On/off status to PLC from blower.
Air Stripper Sump	High level	X	X	X	X	X	Transfer pump P-1		Stop transfer pump P-1
Air Stripper Sump	Level Transmitter	X	X		X				Used as process variable to control VFD and transfer pump P-2 to maintain constant level in sump
Air Stripper Sump	Low level	X	X	X	X		Transfer pump P-2		Stop transfer pump P-2
Transfer Pump P-2	Pump in automatic mode	X			X				Enables automated pump operation by PLC, variable speed based on air stripper sump levels.
Transfer Pump P-2	Pump in hand mode				X				Initiates manual pump operation.
Transfer Pump P-2	Pump running	X			X				On/off status to PLC.
Transfer Pump P-2	pump general overload or fault [3]	X	X	X	X	X	Pump P-2	X	Stop transfer pump P-2
Transfer Pump P-2	VFD fault	X	X		X	X	Pump P-2	X	Stop transfer pump P-2
Transfer Pump P-2	Speed	X			X				Indication of pump speed.
Transfer Pump P-2	Speed reference		X		X				Speed reference signal sent to VFD from PLC.
Effluent Discharge System:									
Plant Effluent Line	Flow transmitter	X			X				Record effluent flow rate

Table 13300 - 2
Process Instrumentation and Controls Description

					Alarms				
					Indication		Shutdown		
Equipment	Condition	PLC Input	PLC Output[1]	Hardwired Interlock	OIT Display	Auto-Dialer	Equipment	System[2]	Comments
Level Transducer in Stormwater Manhole	High level	X	X		X	X		X	System shut down. Time delay to avoid false trips.
Plant effluent line	pH indicating transmitter	X			X				Record pH of discharge water. Adjust MP-1A injection rate.
<u>pH Adjustment System</u>									
Metering pump MP-1/MP-1A	Pump in automatic mode	X			X				Enables automated pump operation by PLC.
Metering pump MP-1/MP-1A	Pump in hand mode				X				Initiates manual pump operation
Metering pump MP-1/MP-1A	Pump running	X			X				On/off status to PLC
Metering pump MP-1/MP-1A	pump general overload or fault [3]	X	X	X	X	X	Metering pump MP-1		Stops MP-1 and notify the operator.
Sodium hydroxide tank	Low level	X	X		X	X	Metering pump MP-1		Stop MP-1 and notify the operator
Sodium hydroxide tank	Low low level	X	X		X	X	Metering pump MP-1/MP-1A	X	Stop MP-1/MP-1A and the system. Notify the operator
Metering pump MP-1 (with greensand filters)	pump general overload or fault [3]	X	X	X	X	X	Metering pump MP-1	X	Stops MP-1 and notify the operator. Shut down the system to protect greensand filters.
<u>OPTIONAL IRON REMOVAL SYSTEM:[5]</u>									
Greensand filters[5]	**OPTIONAL**								
Greensand Filters GSF-1, GSF-2, GSF-3	Pressure differential indicate transmitter	X	X		X	X			Indication of differential pressure across the filter media; send alarm to operator if high differential pressure is detected before backwash time is up
Greensand Filters GSF-1, GSF-2, GSF-3	Timer	X			X		Backwash the respective filter		Control the cycle between service and backwash time
Greensand Filters GSF-1, GSF-2, GSF-3	Flow element	X			X				Record flow rate and total volume of groundwater treated

Table 13300 - 2

Process Instrumentation and Controls Description

Equipment	Condition	PLC Input	PLC Output(1)	Hardwired Interlock	Alarms: Indication: OIT Display	Alarms: Indication: Auto-Dialer	Alarms: Shutdown: Equipment	Alarms: Shutdown: System(2)	Comments
PLC for GSF-1, GSF-2, GSF-3	greensand filters in filtration or backwash mode		X		X		valves		Operate valve open or close based on preset operation and backwash conditions
Influent valve, Effluent valve, backwash valve, waste valve for each filter	Position indicator	X			X				Indicate the valve is open or close
Valve or actuator	malfunction	X	X		X	X	Greensand filters	X	Send alarm to the operator, if individual greensand unit is down, no need to shut down the system, if two or more greensand filters are down, shut down the treatment system
Combined header of backwash waste line	flow switch	X	X		X		MP-3 on or off		detection of flow in waste line will turn on/off ferric chloride metering pump MP-3
Sodium hypochlorite feed system	**OPTIONAL**								
Metering Pump MP-2	Pump in automatic mode	X			X				Enables automated pump operation by PLC.
Metering Pump MP-2	Pump in hand mode				X				Initiates manual pump operation
Metering Pump MP-2	Pump running	X			X				On/off status to PLC
Metering Pump MP-2	pump general overload or fault (1)	X	X	X	X	X	Metering pump MP-2		Stop MP-2 and notify the operator
Sodium hypochlorite tank	Low level	X	X		X	X			Stop metering pump MP-2. Notify the operator to refill
Sodium hypochlorite tank	Low low level	X	X		X	X	Metering pump MP-2	X	Stop metering pump MP-2 and system. Notify the operator
Effluent line of greensand filtration system	Chorine analyzer	X			X				Analyze and record chlorine concentrations after greensand filters
Ferric chloride feed system	**OPTIONAL**								

Table 13300 - 2

Process Instrumentation and Controls Description

					Alarms				
					Indication		Shutdown		
Equipment	Condition	PLC Input	PLC Output(1)	Hardwired Interlock	OIT Display	Auto-Dialer	Equipment	System(2)	Comments
Metering Pump MP-3	Pump in automatic mode	X			X				Enables automated pump operation by PLC.
Metering Pump MP-3	Pump in hand mode				X				Initiates manual pump operation
Metering Pump MP-3	Pump running	X			X				On/off status to PLC
Metering Pump MP-3	pump general overload or fault (1)	X	X	X	X	X	Metering pump MP-3		Stop MP-3 and notify the operator
Ferric chloride storage tank	Level low	X	X		X	X	Metering pump MP-3		Stop MP-3 and notify the operator to refill
<u>Sludge Handling System:</u>(4)	**OPTIONAL**								
Sludge Settling Tank	High level	X	X		X	X			Send alarm to operator and can not backwash greensand units
Sludge Settling Tank	Low level	X	X		X	X	Transfer pump P-3		Stops transfer pump P-3
Sludge Settling Tank	Timer	X	X		X				Set the settling cycle. Set operation time for the mixer and start transfer pumps P-3 at the end of settling cycle.
Transfer Pump P-3	Pump in automatic mode	X			X				Enables automated pump operation by PLC.
Transfer Pump P-3	Pump in hand mode				X				Initiates manual pump operation.
Transfer Pump P-3	pump general overload or fault (3)	X	X	X	X	X	Pump P-3		Shut down pump P-3, send alarm to operator
Transfer Pump P-3	Pump running	X			X				On/off status to PLC.
PLC for Transfer Pump P-3	Timer	X	X		X				Set frequency and duration of pumping for transfer pump P-3
Sludge Holding Tank	High level	X	X		X	X	Pump P-4		Send alarm to operator
Sludge Transfer Pump P-4	Pump in automatic mode	X			X				Enables automated pump operation by PLC.

Table 13300 - 2
Process Instrumentation and Controls Description

					Alarms				
					Indication		Shutdown		
Equipment	Condition	PLC Input	PLC Output$^{(1)}$	Hardwired Interlock	OIT Display	Auto-Dialer	Equipment	System$^{(2)}$	Comments
Sludge Transfer Pump P-4	Pump in hand mode				X				Initiates manual pump operation.
Sludge Transfer Pump P-4	Pump running	X			X				On/off status to PLC from pump controller, P-4 shut down set by timer.
Sludge Transfer Pump P-4	pump general overload or fault $^{(3)}$	X	X	X	X	X	Pump P-4		Shut down pump P-3
Sludge Transfer Pump P-4	Timer	X	X		X				Start sludge transfer pump P-4 at the end of settling cycle in sludge settling tank. Running
Plant Effluent Discharge System	**OPTIONAL**								
Discharge line	motorized butterfly valve or globe valve open/close	X	X		X				When filling up clean water tank, the valve to T-7 opens; the valve to manhole closes, vice versa.
Clean Water Tank (T-7)	**OPTIONAL**								
Clean Water Tank	High level	X	X		X		Close butterfly valve on plant discharge line		Close the valve on discharge line connected to the clean water tank, discharge treated water to stormwater manhole
Clean Water Tank	Low level	X	X		X		Stop transfer pump P-5		Stops transfer pump P-5
Transfer Pumps P-5	Pump in automatic mode	X			X				Enables automated pump operation by PLC.
Transfer Pumps P-5	Pump in hand mode				X				Initiates manual pump operation.
Transfer Pumps P-5	pump general overload or fault $^{(3)}$	X	X	X	X	X	Pump P-5		Shut down pump P-5. Cannot backwash greensand filter(s).
Transfer Pumps P-5	Pump running	X			X				On/off status to PLC.
PLC	Timer	X	X		X				Set the time for transfer pump P-5 to operate in coordination with backwash cycle

Table 13300 - 2

Process Instrumentation and Controls Description

					Alarms				
					Indication		Shutdown		
Equipment	Condition	PLC Input	PLC Output[1]	Hardwired Interlock	OIT Display	Auto-Dialer	Equipment	System[2]	Comments
Spill Containment System:									
Sump Pump (SMP-1)	Pump in automatic mode	X			X				Enables automated pump operation by sump pump controller.
Sump Pump (SMP-1)	Pump in hand mode				X				Initiates manual pump operation.
Sump Pump (SMP-1)	Pump running	X			X				On/off status to PLC from pump.
Sump	High level [6]	X	X		X	X			Starts sump pump.
Sump	Low level [6]	X	X		X		sump pump (SMP-1)		Stops sump pump.
Sump	High high level	X	X	X	X	X		X	Shuts down system.
Chemical Storage Tank Containment	High level	X	X		X	X			check if chemical storage tanks leak

Notes:

(1) Conditions and flow data will be shown on the OIT.
(2) System shut-downs include shut down of all pumps and the blower. Well pump shall be shut down first, blower shall be shut down with time delay to prevent discharge of untreated water.
(3) General fault conditions include, overvoltage, under voltage, speed reduction, over temperature, and overload.
(4) Transfer pump operation will alternate between the two pumps.
(5) Greensand control system including the controls for sodium hypochlorite feed system will be provided by the vendor. The controls shown in this table are minimal description of the controls the greensand vendor shall provide. Vendors control system shall include an interface to be integrated into the treatment system PLC.
(6) High and low level controls are integral to the sump pump design. The sump pump is not controlled by the PLC.
(7) With greensand filters in the treatment train, it is assumed that the backwash supernatant will be periodically pumped from the sludge settling tank into the equalization tank. This additional volume of water shall be evenly distributed to the subsequent treatment components over time. Therefore, the PLC shall be programmed so that as water level increases from a preset water level A, the PLC will control the transfer pump P-1 to increase pumping rate proportionally up to a preset maximum. This preset maximum pumping rate shall be slightly higher than the influent flow rate. The water level in the equalization tank will increase until transfer pump P-3 stops. When the water level drops back to level A, the PLC will control the pump P-1 to operate at the same flow rate as infuent. The volume in equalization tank between level A and the high water level shall be greater than the volume of supernatant to be transferred into the equalization tank.

DGW - discharge to groundwater
NYSPDES - New York State Pollutant Discharge Elimination System
OIT - operator interface terminal
PLC - programmable logic controller
VFD - variable frequency drive

ATTACHMENT A

Section 13300, Attachment A
Description of Process Controls

1.1 Overview

The GWTF will be equipped with a programmable logic controller (PLC), electronic instrumentation and controls, and mechanical equipment to: 1) allow for automated process operation and control, 2) protect process equipment from damage, and 3) prevent unforeseen hazardous and undesirable conditions associated with groundwater treatment system operations. The process instrumentation and control logic for the GWTF is summarized below and tabulated in Table 13300 -2. The process flow and instrumentation diagram for the GWTF is included on Contract Drawings, Sheets-5 and 6.

1.2 Control Panel, PLC, and Auto Dialer

1.2.1 Description of Controls

The GWTF will be equipped with a main control panel, which will contain the following:

- Operator Interface Terminal (OIT)
- PLC that records data/information from process instrumentation (e.g., instantaneous rate and totalized flow) and equipment, monitors the operational status of process equipment (e.g., on/off), performs limited changes in process operations (e.g., pumps on/off, system shutdown), and initiates communications (internal/external) to convey operational status information within the programmed constraints
- Auto-dialer that executes PLC-initiated communications (internal/external) via annunciator and phone
- Dial-in (i.e., via internet) capabilities to allow for remote operational status inquiries and programming changes
- Uninterruptible Power Supply (UPS) to provide power to the control panel during a power outage

PLC-initiated external communications will be executed by the auto-dialer according to how the PLC has been programmed. The PLC will be programmed either on site using a lap top computer, or from a remote location via a broadband connection. For telephone communications, multiple contacts and phone numbers will be included in the programming. The auto-dialer will initiate communications by starting with the first contact, which will be the plant operator. If the auto-dialer does not reach the primary contact, it will continue by initiating communication with lower-tier contacts in the programmed order, until a contact has been reached and the alarm has been acknowledged. For treatment building fire and intrusion alarms, a security company will be notified in addition to the plant operator and/or lower-tier contacts.

Once the fault conditions have been cleared, the PLC will restart the system automatically through a programmed restart sequence.

1.2.2 Fault Conditions and System Responses

Global fault conditions of the groundwater treatment system are described below:

- General:

  All fault conditions described in this section will notify the system operator through an audible/visual alarm at the OIT in the GWTF and initiate external communication through the auto-dialer.

- Power failure:

  In the event of a power failure, the entire treatment system will shut down. The PLC will, in turn, initiate external communication of this fault condition and continue to monitor the status of the system, based on backup power supplied by a UPS. After the power has been restored, if no fault conditions exist, the PLC will restart the system automatically through a programmed restart sequence.

  A power failure detection signal will be sent directly to the auto-dialer in addition to PLC.

- PLC Processor Fault:

  The PLC inputs/outputs will be configured in a fail-safe manner such that, upon a PLC fault, the entire treatment system will shut down and external communication of the fault condition will be initiated.

- Emergency Stop:

  An emergency stop station (manual button) will be included in the process room to manually shut down the system on emergency conditions.

1.3 Groundwater Extraction System

1.3.1 Description of Controls

The three groundwater extraction wells (EW-1S, EW-1I, and EW-1D) will be operated simultaneously. The effluent line of each pump will be equipped with a flow indicating transmitter and a motorized globe valve to control the flow rate. The flow rate from each extraction well will be displayed on the OIT. The three effluent lines will be combined into one influent header that discharges to the equalization tank at the treatment plant as shown on the Contract Drawings.

Each extraction well will be equipped with a level transducer to prevent the pump from running dry. Pump protection features are hardwired to shut down the pump upon a fault condition in both manual and automatic mode. Additional controls are as follows:

- The extraction well pumps can be operated manually under Hand Mode or automatically by PLC under Auto Mode.

- The operational status of well pumps will be displayed on the OIT.

- Each extraction well pump will have a pump status box for pump protection under the following conditions: over-voltage, under-voltage, dry run, speed reduction, over-temperature, and over-load.

- The influent header will be equipped with a pressure switch in the well vault.

1.3.2 Fault Conditions and System Responses

- Well pump failure:

  For each pump, the following fault conditions will be transmitted to the PLC from the pump status box and will be hardwired to shut off the pump: over-voltage, under-voltage, dry run, speed reduction, over-temperature, and over-load. The PLC in turn will not try to restart the pump until the fault condition is reset.

- High pressure in influent header:

  The high pressure switch will signal the PLC and send an alarm. The PLC will shut down the well pumps and will initiate the auto-dialer.

- Low water level in extraction well:

  At the detection of an unacceptably low water level, the PLC will shut down the extraction well pump in that well to prevent the pump from running dry, send an alarm, and will initiate the auto-dialer.

The well pumps will also be shut down due to the following fault conditions described in other sections:

- High high level in equalization tank

- High level in the air stripper sump

- Low pressure on the discharge line of air stripper blower B-1

- High water level in the stormwater manhole where treated groundwater is discharged

- High high level in building sump, with time delay to avoid false trips.

1.4 Equalization Tank (T-1) and Transfer Pump (P-1)

1.4.1 Description of Controls without Iron Removal System

The equalization tank (T-1) is used to equalize the groundwater quality and flow fluctuation that may occur. Effluent from the equalization tank will be pumped into the duplex bag filter system with a VFD and transfer pump P-1. The equalization tank will be equipped with level switches and a level indicating transmitter to control the operation of the VFD of the transfer pump. A pH analyzer will also be installed in the equalization tank for the dosage control of the caustic feed system.

1.4.2 Fault Conditions and System Responses without Iron Removal System

- Pump failure:

  The following fault conditions will be transmitted to the PLC from the pump status box and will be hardwired to shut off the pump: over-voltage, under-voltage, dry run, speed reduction, over-temperature, and over-load. The PLC will not try to restart the pump until the fault condition is reset. An alarm will be sent to the operator and the PLC will initiate the auto-dialer.

- VFD fault condition:

  A VFD fault condition will shut down the transfer pump (P-1) and the system. An alarm will be sent to the operator and the PLC will initiate the auto-dialer.

- Discharge of untreated water when the equalization tank transfer pump (P-1) is operating in HAND mode:

  Transfer pump P-1 will be programmed so that the transfer pump P-1 cannot operate unless the air stripper blower is running at full speed.

- High high water level in equalization tank:

  The PLC will shut down the well pumps, initiate the auto-dialer and send an alarm to the operator.

- Low low water level in equalization tank:

  The PLC will shut down the transfer pump P-1, initiate the auto-dialer and send an alarm to the operator.

1.4.3 Optional - Description of Controls with Iron Removal System

If iron removal is required, the equalization tank will provide sufficient buffer capacity to hold the supernatant pumped from the sludge settling tank and allow it to be distributed evenly over time to the subsequent treatment units. Effluent from the equalization tank will be pumped into the greensand filtration units with transfer pumps P-1. The general operation and controls are the same as described in Section 4.4.1 and 4.4.2 except the control of transfer pump P-1, which is based on the water level data from the water level indicating transmitter. Additional controls are as follows:

- Level transmitter:

The level transmitter will be used to control transfer pump P-1 to operate at variable flow rates to accommodate supernatant from the sludge settling tank.

- High water level:

  The high water level in the equalization tank indicates that the supernatant from the sludge settling tank is pumped into the equalization tank. The PLC will control the VFD of transfer pump P-1 to pump at a flow rate higher than the influent flow rate from the well pumps.

- Low water level:

  The low water level in the equalization tank indicates that the supernatant from the sludge settling tank has been redistributed into the treatment system. The PLC will control the VFD and transfer pump P-1 to operate at the same flow rate as the influent based on the feedback from the influent flow meter. (The PLC will also send a signal to the PLC controlling transfer pump P-3 that the equalization tank is ready to accept flow from the sludge settling tank.)

- Low low water level:

  The low low water level in the equalization tank will be set to provide sufficient buffering volume for transfer pump P-1 to adjust to the low influent flow rate. The low low water level switch will send an alarm to the operator. The PLC will stop transfer pump P-1 and initiate the auto-dialer and notify the operator.

1.5 Bag Filters

A duplex bag filter system with two bag filters will be used with one in operation at any given time. A differential pressure switch will be installed on the common influent and effluent lines of the duplex bag filter system. At a high differential pressure, an alarm will be sent to the OIT. The PLC will shut down the system and initiate the auto-dialer to alert the operator for bag filter change out.

1.6 Air Stripper System and Transfer Pumps (P-2)

1.6.1 Description of Controls

The air stripper system includes the air stripper and the blower B-1. A transfer pump (P-2) with VFD will be provided for the discharge of treated groundwater. The air stripper sump will be equipped with level switches and a level transmitter to control the speed of the VFD at transfer pump (P-2), and maintain a constant water level in the sump. Additional controls are described below:

- Blower B-1 will start first by the PLC; well pumps will start with time delay. Transfer pump P-2 will be turned on at the detection of a preset water level in the air stripper sump.

- A low level switch in the air stripper sump will shut down transfer pump P-2 to prevent the pump from running dry.

- The blower (B-1) will be equipped with a low pressure switch to detect fault conditions for the blower and blower discharge line.

- The transfer pump (P-2) can be operated under Hand Mode or Auto Mode.

1.6.2 Fault Conditions and System Responses

- Discharge of untreated groundwater due to blower malfunction:

  Under all blower fault conditions as described in this section, the entire system will be shut down by the PLC.

- Discharge of untreated groundwater during system startup and shutdown:

  The PLC will be programmed to include delays at transfer pump (P-2) start and stop to allow for: 1) the blower to reach full speed before the transfer pump turns on (e.g., 15-30 second delay) and 2) treatment of the groundwater in the air stripper after the transfer pump shuts down (e.g., 1-2 minute delay). The transfer pump will not be able to start if a fault condition exists for the air stripper or blower.

- High level in air stripper sump

  The high level switch in the air stripper sump allows the detection of an unacceptably high water level and will send a signal to the PLC to shut down the system, including the well pumps. A time-delay will be provided for the blower to avoid discharge of untreated water.

- Damage to the blower shaft during a quick restart:

  The PLC will be programmed to include an operator adjustable delay after shutdown (e.g., 2-5 minute delay) to allow the blower to reach a complete stop before it can be restarted.

- Low pressure on the blower discharge line:

  The PLC will automatically shut down the system when a low pressure is detected.

- VFD fault condition:

  A VFD fault condition will shut down the transfer pump P-2 and the entire system.

- Pump Failures:

  PLC will shut down the transfer pump (P-2) and the entire system. PLC will initiate the auto-dialer; and an alarm will be sent to the operator.

The PLC will initiate the auto-dialer; an alarm will be sent to the operator.

- Low level in caustic storage tank (T-2)

  The PLC will initiate the auto-dialer. An alarm will be sent to the operator.

- Low low level in caustic storage tank (T-2)

  The PLC will shut down MP-1/MP-1A and the system, and initiate the auto-dialer. An alarm will be sent to the operator.

1.9 Optional – Greensand Filtration System and Sodium Hypochlorite Feed System

1.9.1 Description of Controls

Three greensand filters will be operated in parallel under service conditions. During backwash, groundwater will be treated through two greensand filters at the design flow rate. Plant effluent will be stored in a clean water tank (T-7) and used to backwash greensand filters. The backwash generally involves 10-minute backwash, 15-minute settling, followed by 3-minute rinse. Both backwash wastewater and rinse water will be discharged to the sludge settling tank. Each greensand filter will be equipped with a differential pressure switch, a flow transmitter, a timer, and electric motor actuated butterfly valves on the influent and effluent lines during service, backwash influent lines, and waste lines. Backwash can be triggered by a programmed timer, a preset high differential pressure, or a preset maximum volume of groundwater treated. Under normal operational conditions, it is preferred that the backwash cycle be controlled by a timer. The PLC will be programmed to open and close valves under service conditions or backwash conditions.

A sodium hypochlorite feed system will be used to continuously regenerate the greensand media. The sodium hypochlorite feed metering pump can be operated manually or automatically by the PLC. A chlorine analyzer will be installed in the effluent line of the greensand filtration system to monitor effluent chlorine concentrations. The chlorine concentration will be transmitted to the PLC; in turn, the PLC will control the dosing rate of sodium hypochlorite by controlling the metering pump.

1.9.2 Fault Conditions and System Responses

- Electric motor actuated butterfly valve malfunction:

  The PLC will shut down the system and initiate the auto-dialer. An alarm will be sent to the operator.

- Backwash failure:

  If backwash of greensand filters cannot be initiated due to transfer pump P-3 or P-5 failure or other reasons, The PLC will shut down the system and initiate the auto-dialer. An alarm will be sent to the operator.

1.7 Effluent Discharge System

1.7.1 Description of Controls

Treatment plant effluent will be pumped by a transfer pump (P-2) to the stormwater manhole located in front of Garden City Well Field #10 and #11, and eventually discharged to recharge basin #124. The effluent line will include an electronic flow meter with flow indicating transmitter to allow for the recording of instantaneous flow and total flow by the PLC. The operator can totalize the volume of discharged water and use the data to complete monthly reports and NYSPDES discharge monitoring reports.

The stormwater manhole will be equipped with a high level switch for detection of unacceptably high water levels during unusual storm events and allow the system to shut down.

The effluent line will also be equipped with a pH analyzer to monitor the pH of discharged groundwater. Based on the pH data, the operator can adjust the caustic feed rate to meet NYSPDES permit equivalent requirements.

1.7.2 Fault Conditions and System Responses

- High water level in stormwater manhole:

If the water level in the stormwater manhole rises above the high level switch, the PLC will shut down the entire treatment system including extraction well pumps; initiate an auto-dialer and notify the operator through an alarm.

1.8 Caustic Feed System

1.8.1 Description of Controls

To correct the low groundwater pH, caustic solution from the storage tank (T-2) will be fed into the equalization tank (T-1) to enhance iron removal (and to correct the pH for proper operation of greensand filters, as necessary). The pH measurement data collected in the equalization tank will be sent to the PLC, which will set the dosage rate for the caustic chemical feed metering pump (MP-1).

In addition, pH can drop through the treatment processes (such as air stripper). Caustic solution will also be added in the plant effluent discharge line to ensure that the pH of treated water will meet NYSPDES permit requirement. A pH analyzer will be placed after the inline mixer to monitor the pH continuously. If the pH is outside the permit requirement value, the PLC will control metering pump (MP-1A) to adjust caustic solution dose.

The operation of the metering pumps (MP-1 and MP-1A) is controlled manually or by the PLC. The caustic feed metering pumps will be turned on and off by the PLC in accordance with the on and off of the well pumps. The caustic storage tank (T-2) will be equipped with a low level switch and a low low level switch.

1.8.2 Fault Conditions and System Responses

- Metering pumps (MP-1/MP-1A) Failures:

- Sodium hypochlorite metering pump (MP-2) failure:

  The PLC will shut down the system. An alarm will be sent to the operator. A time delay will be provided to avoid false trips.

- Low level in sodium hypochlorite storage tank (T-5):

  The PLC will initiate the auto-dialer. An alarm will be sent to the operator.

- Low low level in sodium hypochlorite storage tank (T-5):

  The PLC will shut down MP-1 and the system, initiate the auto-dialer. An alarm will be sent to the operator.

1.10 Optional - Sludge Settling Tank (T-3), Transfer Pump (P-3), and Ferric Chloride Feeding System

1.10.1 Description of Controls

The sludge settling tank will be operated between the settling and transfer cycles. Once backwash and rinse of a greensand filter is complete and the sludge settling tank is filled with waste water, the sludge settling tank will be in settling mode. A timer will be programmed to allow the suspended solids to settle out in the sludge settling tank. At the end of the settling cycle and upon detection of a low level in the equalization tank, the PLC will start the transfer pump P-3 and pump the supernatant from the settling tank to the equalization tank. Transfer pump P-3 will be shut down by the PLC at a preset low water level in the sludge settling tank or by the timer.

Ferric chloride solution will be used as coagulant to enhance settling of iron sludge. The ferric chloride feeding system will include a storage tank (T-6), a metering pump (MP-3) and associated apparatus. Ferric chloride solution will only be added during a backwash cycle. A flow switch will be installed in the waste line of the greensand filtration system to control the operation of MP-3. MP-3 will be turned on with the detection of flow in the waste line and shut down when flow in the waste line stops.

1.10.2 Fault Conditions and System Responses

- High water level in equalization tank (T-1):

  A high water level in the equalization tank will cause the PLC to shut down transfer pump P-3. If transfer pump P-3 is stopped before the water level in the sludge settling tank has been dropped to the low level, an alarm will be sent to the operator and the PLC will initiate the auto-dialer.

- High level in sludge settling tank (T-3):

  The PLC will suspend the backwash of greensand filters. The PLC will initiate the auto-dialer. An alarm will be sent to the operator.

- Transfer pump (P-3) failure:

  The following fault conditions will be transmitted to the PLC from the pump status box and will be hardwired to shut off the pump: over-voltage, under-voltage, dry run, speed reduction, over-temperature, and over-load. The PLC will not try to restart the pump until the fault condition is reset. An alarm will be sent to the operator. The PLC will initiate an auto-dialer.

- Coagulant (ferric chloride) metering pump (MP-3) failure:

  The PLC will initiate an auto-dialer. An alarm will be sent to the operator.

- Low level in coagulant storage tank (T-6):

  The PLC will initiate the auto-dialer. An alarm will be sent to the operator.

1.11 Optional - Sludge Holding Tank (T-4) and Transfer Pump (P-4)

4.11.1 Description of Controls

At the end of the settling cycle in the sludge settling tank controlled by a timer, sludge accumulated at the bottom of the sludge settling tank will be pumped into a sludge holding tank (T-4) by a transfer pump P-4. A timer will be programmed so that the transfer pump P-4 will only be operated for a preset amount of time and then will be shut down by the PLC.

The operator will arrange to empty the sludge holding tank once a week.

The sludge holding tank will be equipped with a high level switch. Upon detection of an unacceptably high sludge volume, an alarm will be sent to the operator and the PLC will initiate the auto-dialer.

1.11.2 Fault Conditions and System Responses

If any pump failures of the transfer pump P-4 occur, an alarm will be sent to the operator and the PLC will initiate the auto-dialer.

- Transfer pump (P-4) failure:

  The following fault conditions will be transmitted to the PLC from the pump status box which will be hardwired to shut off the pump: over-voltage, under-voltage, dry run, speed reduction, over-temperature, and over-load. The PLC will not try to restart the pump until the fault condition is reset. An alarm will be sent to the operator. The PLC will initiate the auto-dialer.

1.12 Optional – Clean Water Tank (T-7) and Transfer Pump (P-5)

4.12.1 Description of Controls

To backwash the greensand filters, a clean water tank and a transfer pump P-5 are selected. Treated water from the air stripper will be stored in T-7 and used in greensand filter backwash. Two motorized valves will be installed, one on the effluent discharge line and one on the influent line to T-7 as shown on the Contract Drawings. After each backwash, the PLC will close the valve on plant effluent discharge line and open the valve on influent line to T-7 to fill up the tank (T-7). Once the water level in T-7 reaches the high level, a level switch will signal the PLC to control the open and close of the two valves and discharge treated water to the stormwater manhole. A transfer pump P-5 will be used to pump water from the clean water tank (T-7) to the greensand filter to be backwashed.

1.12.2 Fault Conditions and System Responses

- Transfer pump (P-5) failure:

  The following fault conditions will be transmitted to the PLC from the pump status box which will be hardwired to shut off the pump: over-voltage, under-voltage, dry run, speed reduction, over-temperature, and over-load. The PLC in turn will not try to restart the pump until the fault condition is reset.

  The PLC will initiate the auto-dialer. An alarm will be sent to the operator.

1.13 Treatment Facility Building

1.13.1 Building Sump

1.13.1.1 Description of Controls

The building spill containment sump (SMP-1) will be equipped with high and low level switches to start/stop the sump pump, and a high-high level switch. The high and low level controls are integral to the sump pump design and are not controlled by the PLC.

1.13.1.2 Fault Conditions and System Responses

- High-high water level in sump:

  If the water level inside the sump rises above the high-high level switch, the switch will close and send a corresponding signal to the PLC. The PLC will shut down the entire treatment system, initiate auto dialer and send an alarm to the operator.

1.13.2 Chemical Containment Area

1.13.2.1 Description of Controls

A leak detector will be equipped at the low point within the chemical storage tank and feed system containment area. Upon detection of leakage, an alarm will be sent to the operator and the PLC will initiate the auto-dialer. The operator will check the working condition of the leak detector periodically.

1.13.3 Health and Safety Provisions

1.13.3.1 Description of Controls

The building will also be equipped with several H&S provisions, which will be integrated with the PLC, including but not limited to:

- Fire protection system
- Room vapor monitor (RVM)
- Emergency ventilation system

1.13.3.2 Fault Conditions and System Responses

- High vapor concentrations as detected by the RVM:

The PLC will activate the emergency ventilation system and notify the operator.

SECTION 13405

PROCESS INSTRUMENTATION AND CONTROLS - PRODUCTS

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Refer to SECTION 13300 – GROUNDWATER TREATMENT SYSTEM.

1.1.2 This Section includes the detailed technical requirements for the furnishing, installation, and services for the field and panel-mounted instrumentation and control equipment. All equipment to be supplied for installation in the field shall have aluminum tags with the Device ISA TAG No. attached prior to delivery.

1.2 SUBMITTALS

Refer to SECTION 13300 – GROUNDWATER TREATMENT SYSTEM.

1.3 REFERENCES

Refer to SECTION 13300 – GROUNDWATER TREATMENT SYSTEM.

1.4 QUALITY ASSURANCE

Refer to SECTION 13300 – GROUNDWATER TREATMENT SYSTEM.

1.5 MAINTENANCE

1.5.1 Refer to SECTION 01800 – TREATMENT SYSTEM OPERATION AND MAINENANCE.

1.5.2 Refer to SECTION 13300 – GROUNDWATER TREATMENT SYSTEM for spare parts and test equipment requirements.

1.5.3 Miscellaneous Spare Parts: One year supply of items recommended by the manufacturer of the equipment for each component.

PART 2 PRODUCTS

2.1 FLOW INSTRUMENTS

2.1.1 Flowmeter (Process Water)

2.1.1.1 Flow Element – Magnetic Type

2.1.1.1.1 Type: The magnetic flowmeter shall be of low frequency electromagnetic induction type and shall produce a pulsed DC signal proportional to and linear with liquid flowrate.

2.1.1.1.2 Functional/Performance: Accuracy - Plus or minus 0.5 percent of rate (including converter/transmitter); Power requirements - Match to converter/transmitter; Temperature rating - Suitable for process liquid temperature up to 150 degrees F and an ambient of 140 degrees F; Pressure rating - 150 psi; Provide radio frequency interference (RFI) protection; Meter shall be capable of running empty indefinitely without damage to any component.

2.1.1.1.3 Physical: Metering Tube: ANSI 150 lb, carbon steel flange; Polyurethane Liner; Type 316 stainless steel Electrodes, bullet nosed or elliptical self cleaning type unless otherwise noted; Housing - Meters in below grade vaults and basements shall be designed for accidental submergence in 30-ft of water for 24 hours. Meters above grade shall be of splash proof/drip proof design unless otherwise noted. Where hazardous areas are indicated, the equipment shall be rated for that area. All external surfaces shall be prepainted with a chemical and corrosion resistant epoxy finish.

2.1.1.1.4 Accessories/Options Required: Provide a certified flow curve for each meter; provide grounding rings, ground wires and gaskets. All materials shall be immune to chemical reaction with medium being measured. Where insulated or non-conductive pipe is used, only orifice plate type grounding rings will be acceptable. In order to maintain the integrity of the magnetic flowmeter liner, grounding electrodes will not be acceptable.

2.1.1.2 Flow Converter/Transmitter

2.1.1.2.1 Type: Remote mounted, microprocessor based electronics w/ LCD display, matched to the flow element.

2.1.1.2.2 Functional/Performance: Power requirements - 120 VAC plus or minus 10 percent; Temperature - minus 10 degrees F to plus 140 degrees F; Output - Isolated 4-20 mA into 0 to 1000 ohms; built-in digital indicator and flow totalizer.

2.1.1.2.3 Physical: Housing - NEMA 4X wall mount.

2.1.1.2.4 Accessories/Options Required: Signal converters shall be inter-changeable without recalibration for all meter sizes; A separate terminal strip for power connection shall be supplied; The interconnecting cable shall be supplied with the meter in a 30 ft. Minimum length; Zero Return Unit - Where indicated on the instrument device schedule provide a zero return unit; HART protocol communications compatibility.

2.1.2 Flow Transmitter (Air) - Differential Pressure Indicating Transmitter (for use with annubar).

2.1.2.1 Type: Microprocessor-based, intelligent type; Diaphragm actuated.

2.1.2.2 Functional/Performance: Accuracy - 0.1 percent of span (linear output); Stability - Combined temperature effects shall be less than 0.12 percent of maximum span per 50 degrees F temperature change. Effect on accuracy due to static pressure changes shall be negligible; Power Requirements - Loop powered, two wire type; Output - 4-20 mADC; For flow metering applications the output shall be the square root of the input differential pressure; RFI Protection - 0.1 percent error between 27 and 500 MHZ at 30 v/m field intensity; Drift - 0.10 percent per size months for 4-20 mA output; Sensor Technology - Digital; Over Range Protection - Provide positive over range protection

2.1.2.3 Physical: Electrical Classification - Intrinsically safe for Class I and Class II, Division 1 locations; Enclosure - NEMA 4X; Sensor Diaphragm Material - Cobalt-Nickel-Chrome alloy or Hastelloy C; Gaskets - Teflon; Sensor Fill Fluid - Shall be suitable for process fluid being measured. When used for chemical metering service, sensor fill fluid shall be rated specifically for the chemical being measured; Suitable for chemical service as shown on the Diagrams and as indicated.

2.1.2.4 Options/Accessories Required: Provide span and zero adjustment at each transmitter; Provide local LCD indication at each transmitter. Scale shall be in engineering units; Provide hand held programmer(s) as specified under tools and test equipment; For each transmitter provide a multimatic 5-valve manifold and mounting brackets as required; Transmitter must have HART protocol communications capability; The manifold shall be Type 316 stainless steel integral to the transmitter, and provide the following modes of operation:

(1) Normal Mode
(2) Zeroing Mode
(3) Isolation Mode
(4) Calibration Mode
(5) Blowdown Mode

2.1.3 Flowmeter (Air) – Annubar

2.1.3.1 Flow Element

2.1.3.1.1 Type/Operation: Insertion type using the square root of differential pressure across the element to calculate flow in cfm. Sensing ports on the front of the annubar sense the impact pressure profile and produce a averaged high pressure signal of the DP in the upstream chamber of the probe. The average low pressure portion of the DP signal is sensed by multiple ports on the downstream side of the annubar.

2.1.3.1.2 Functional/Performance: Accuracy - Plus or minus .1 percent of reading plus 0.5 percent full; Power requirements - Match to converter/transmitter; Temperature rating - Suitable for process temperature between (-40 to 350 degrees Fahrenheit); Pressure rating - 250 psi; Repeatability – Plus or minus .5 percent of reading. Minimum differential pressure of 20 inches of water.

2.1.3.1.3 Physical: All welded. 316 stainless steel. Insertion flow element capable of being inserted into process pipe or supplied inline flow tube. Any fittings needed shall be supplied with element.

2.1.3.1.4 Accessories/Options Required: Inline Flow tubes ranging in diameter size from 1 to 2 inches. Process connection shall be Male NPT.

2.1.3.1.5 Differential transmitter chosen in Paragraph 2.1.2 must be compatible with the annubar's differential pressure range.

2.1.4 Thermal Dispersion Flow Switch

2.1.4.1 Type: Thermal dispersion flow switch with integral electronics enclosure; insertion type.

2.1.4.2 Function/Performance: Range: 1 to 125 ft/s (0.3 to 38 m/s) in air; Process Operating Temperature: -40 to 170o C; Operating Temperature for Electronics: -40 to 60o C; Accuracy: Plus/minus 5 percent of reading; Repeatability: Plus/minus 0.5% of reading; Output: DPDT contacts rated 6 A at 120 VAC adjustable over the range of the instrument.

2.1.4.3 Physical: Wetted parts to be 316 stainless steel; Electronics head to be NEMA 4X (IP65) for non-hazardous process gases and explosion proof approved for Class 1, Division 1, Groups C and D (EEx d IIC) for hazardous process gases or where located in a hazardous area; A/C power will be as specified in SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

2.1.4.4 Accessories Required: For insertion type flow elements a hot tap assembly including a ball valve and packing gland that will allow removal of the sensor without shutdown of the process, shall be provided. The hot tap assembly shall be installed in a welded fitting on the pipe.

2.2 LEVEL INSTRUMENTS

2.2.1 Level Transducers

Level transducers for controlling the pumps shall be solid state with no mechanical linkages. Transducers shall be accurate to +/- 1 percent and shall incorporate a four active arm wheatstone bridge strain gage diffused directly into a silicon diaphragm. The transducer shall be 1-inch diameter and wetted materials shall be Type 316 stainless steel and fluorocarbon. The transducer shall be provided with a factory attached Tefzel jacketed water block cable with non-stretch Kevlar stiffeners.

2.2.2 Level Switch - Point Level Ultrasonic Probe

2.2.2.1 Type: Housing - Heavy duty cast aluminum NEMA 4X with 120 VAC contact outputs

2.2.2.2 Operation: Purpose-To detect liquid at a predetermined level without contact and actuate an alarm. Operating Principal -To actuate the control relay when the returning echoes between the sensor and the product level are not detected. The minimum distance between the sensor and maximum product level is determined by the ringing time of the sensor.

2.2.2.3 Functional: Output - DPDT Contacts, 7 Amps, 120 VAC Power Requirements - 120 VAC, 60 Hz.

2.2.2.4 Physical: Probe – 316 Stainless Steel; Mounting - Suitable for flange or 3/4" NPT threaded coupling as required.

2.2.2.5 Performance: Sensitivity- response time of 2 seconds and a repeatability of 1/16 inch.

2.2.3 Level Transmitter

2.2.3.1 Type: Two-wire, capacitance or solid-state based; high performance differential pressure transmitter with H.A.R.T. based digital communications capabilities; small, lightweight design.

2.2.3.2 Operation Purpose: To sense pressure and produce a standard current output signal linear with level or flow; sensing element - differential capacitance cell; circuitry - solid state with software selectable square root extraction; indicator - integrally mounted scaled in engineering units; Gauge and absolute shall have integral three valve manifold and differential shall have integral five valve manifold.

2.2.3.3 Functional: Static pressure limit - 2000 PSIG; power supply - DC (loop powered); output - 4-20 mADC; communications protocol - H.A.R.T.; integral non-interactive zero and span adjustments; integral 4-digit LCD indicator of the level; non-volatile memory; self-diagnostic capability.

2.2.3.4 Physical: Wetted parts - 316 stainless steel, glass filled TFE; body material - low-copper aluminum or Type 316 stainless steel; electronics housing - NEMA 4X with FM approval; process connections 1/2-in NPT; traditional biplaner design flange.

2.2.3.5 Performance: Accuracy - plus or minus 0.075 percent of span over a 100:1 range including the combined effects of linearity, hysteresis and repeatability; stability - plus or minus 0.10 percent of URL for a 12-month period; static pressure effect - (zero error) plus or minus 0.10 percent of URL per 1,000 PSI, (span) plus or minus 0.20 percent of reading per 1000 PSI; temperature effect - plus or minus 0.025 percent of URL plus 0.125 percent of span per 50 degrees F; vibration effect - plus or minus 0.1 percent of URL per g when tested from 15 to 2,000 Hz in any axis.

2.2.4 Level Switch Capacitance Probe

2.2.4.1 Type: RF Admittance

2.2.4.2 Operation: Purpose-To detect liquid at a predetermined level and actuate an alarm. Operating Principal - To produce a change in capacitance when the liquid, at a predetermined level, reaches the probe which causes the control relay to be actuated.

2.2.4.3 Functional: Output – 2 DPDT Contacts, 5 Amps, 120 VAC; Power Requirements – 115 VAC, 60 Hz.

2.2.4.4 Physical: Probe - 316 Stainless steel. Mounting - Suitable for flange or threaded coupling as required. Probe material shall be suitable for chemical that is storage in that tank or containment area. Housing - Heavy duty cast aluminum NEMA 4X, FM approved.

2.2.4.5 Performance: Sensitivity - Sense capacitance of process material with dielectric constant as low as 1.5. Switch shall actuate when probe tip is covered by less than ½-in of process fluid regardless of probe length.

2.2.5 Multipoint Level Switch Capacitance Probe

2.2.5.1 Type: RF Admittance

2.2.5.2 Operation: Purpose-To detect liquid at up to 4 predetermined levels and actuate alarms. Operating Principal - To produce a change in capacitance when the liquid, at a predetermined level, reaches the probe setting which causes the control relay to be actuated.

2.2.5.3 Functional: Output - 3 DPDT Contacts, one with adjustable differential, 5 Amps, 120 VAC; Power Requirements - 115 VAC, 60 Hz.

2.2.5.4 Physical: Probe - 316 Stainless steel. Mounting - Suitable for flange or threaded coupling as required. Probe material shall be suitable for chemical that is storage in that tank or containment area. Housing - Integral NEMA 4X , Explosionproof, FM approved.

2.2.5.5 Performance: Sensitivity - Sense capacitance of process material with dielectric constant as low as 1.5.

2.2.6 Level Switch Float Type

2.2.6.1 Type: Dry contact float switch; provides positive switching action even in turbulent conditions. Mercury switches are not allowed.

2.2.6.2 Function/Performance: Output: SPDT contact rated 20 A at 240 VAC; Deadband: Deadband adjusted by location of anchoring point on cable.

2.2.6.3 Physical: PVC float; PVC sheathed cable with strain relief at float connection. Sufficient cable length shall be provide so that no splice is required in the wet well, reservoir, or process vessel. Adjustable strain relief for anchoring point.

2.3 PRESSURE INSTRUMENTS

2.3.1 Pressure Transmitter (Absolute, Gauge, Differential)

2.3.1.1 Type: Two-wire, capacitance or solid-state based; high performance pressure transmitter with H.A.R.T. based digital communications capabilities; small, lightweight design.

2.3.1.2 Operation Purpose: To sense pressure and produce a standard current output signal linear with level or flow; sensing element - differential capacitance cell; circuitry - solid state with software selectable square root extraction; indicator - integrally mounted scaled in engineering units; Gauge and absolute shall have integral two valve manifold and differential shall have integral five valve manifold.

2.3.1.3 Functional: Static pressure limit - 2000 PSIG; power supply - DC (loop powered); output - 4-20 mADC; communications protocol - H.A.R.T.; integral non-interactive zero and span adjustments; integral 4-digit LCD indicator of the pressure or the flow; non-volatile memory; self-diagnostic capability.

2.3.1.4 Physical: Wetted parts - 316 stainless steel, glass filled TFE; body material - low-copper aluminum or Type 316 stainless steel; electronics housing - NEMA 4X with FM approval; process connections 1/2-in NPT; traditional biplaner design flange.

2.3.1.5 Performance: Accuracy - plus or minus 0.075 percent of span over a 100:1 range including the combined effects of linearity, hysteresis and repeatability; stability - plus or minus 0.10 percent of URL for a 12-month period; static pressure effect - (zero error) plus or minus 0.10 percent of URL per 1,000 PSI, (span) plus or minus 0.20 percent of reading per 1000 PSI; temperature effect - plus or minus 0.025 percent of URL plus 0.125 percent of span per 50 degrees F; vibration effect - plus or minus 0.1 percent of URL per g when tested from 15 to 2,000 Hz in any axis.

2.3.2 Pressure (Vacuum) Switch

2.3.2.1 Type: Diaphragm actuated, adjustable deadband, automatic reset.

2.3.2.2 Functional/Performance: Repeatability - Better than 1.0 percent of pressure range; Set Point - Field adjustable and set between 30 and 70 percent of the adjustable range; Deadband - Adjustable up to a maximum of 100 percent of switch range; overrange Protection - Provide overrange protection to maximum process line pressure; switch Rating - 250 VAC at 10 Amps and 30 VDC at 5 amps; reset- automatic with adjustable deadband.

2.3.2.3 Physical: Housing - NEMA 4X; Switching Arrangement - SPDT; Wetted Parts - Teflon coated diaphragm, viton seals, stainless steel connection port; connection Size - ½-in NPT.

2.3.2.4 Accessories/Options Required: Shutoff Valve - Provide process shutoff valve which can be used as an adjustable pressure snubber; Chemical seals - Provide and install between the process line and pressure switches whenever the process line contains corrosive fluids or solids bearing fluids. For corrosive, non-solids bearing fluids, the chemical seal shall be a diaphragm type. The seal shall have a flushing connection and a bleed valve to allow filling after installation. Solids bearing process lines shall have a non-clogging in-line spool or wafer type chemical seal. Pressure switches shall be constructed so that all wetted parts are compatible for the particular chemical service.

2.3.3 Differential Pressure Switch

2.3.3.1 Type: Diaphragm actuated.

2.3.3.2 Function/Performance: Setpoint: Field adjustable and set between 30 and 70 percent of the adjustable range; Dead Band: Fixed deadband; Over Range Protection: Over range protection to twice the maximum process line pressure; Output: Dry contacts rated 10 A at 230 VAC. Single pole double throw (SPDT) unless requirement for double pole double throw (DPDT) switches is shown on the instrument device schedule.

2.3.3.3 Physical: Housing: NEMA 4X (IP65) for non hazardous areas. For installation in hazardous areas, housing shall be explosion proof approved for Class 1, Division 1, Groups C and D (EEx d IIB T5); Switching Assemblies: Hermetically sealed switches; Wetted Parts: 316L stainless steel diaphragm, viton seals, 316 stainless steel connection port

2.3.3.4 Accessories/Options Required: For each differential pressure switch, provide a three valve manifold. The manifold shall be 316 stainless steel. Manifolds shall be D/A Manufacturing or Anderson Greenwood.

2.3.4 Field Mounted Indicators

2.3.4.1 Type: Dial indicator for field mounting.

2.3.4.2 Function/Performance: Accuracy: Air: +/- 0.25 percent of scale, liquid: +/- 1 percent of scale; Display: 4-1/2 inch with white background and black markings.

2.3.4.3 Physical: Suitable for surface or pipe stand mounting; ¼ inch NPT Type 316 SS socket, Type 316 SS case and Bourdon tube; 300 series stainless steel movement; blowout back design; liquid filled with glycerin and provided with a filler/breather cap.

2.3.4.4 Accessories: Air service: needle type isolation valve; liquid service: snubber and ball type isolation valve.

2.4 TEMPERATURE INSTRUMENTS

2.4.1 Temperature Indicating Transmitter

2.4.1.1 Thermowell

2.4.1.1.1 Type: Threaded, Insertion length to suit application.

2.4.1.1.2 Operation: Function - To separate the temperature-measuring sensitive portion of a filled thermal system, thermocouple, or resistance temperature detector from potentially corrosive or damaging process media, and/or provide isolation for removal.

2.4.1.1.3 Functional: Connection - Pipe tap-threaded well, drilled construction.

2.4.1.1.4 Physical: Material - Type 316 stainless steel; Tip Length - 90mm (3.5-in) minimum; Lagging Extension - 75mm (3-in) minimum; Suitable for chemical service as shown on the Drawings and as indicated. Shall be compatible with length of RTD.

2.4.1.1.5 Performance: Hydrostatically pressure tested at 2500 psi at 75 degrees F.

2.4.1.2 Resistance Temperature Detector (RTD)

2.4.1.2.1 Type: Platinum sensor, strain free; with well assembly.

2.4.1.2.2 Operation: The metal changes electrical resistance uniformly with temperature.

2.4.1.2.3 Function: Platinum resistance temperature sensor; Three lead external connecting wire; Mounting within 1/4-in bore well.

2.4.1.2.4 Physical: Sensor - Platinum; Sheath all welded and hermetically sealed Type 316 stainless steel; Well - Hastelloy C or as recommended by the manufacturer for the service, 3/4-in NPT process connection with fittings as required for insertion into a tank sidewall nozzle or process piping. Shall be compatible with length of thermowell.

2.4.1.2.5 Performance: Accuracy - Plus or minus 0.5 degree F or plus or minus 0.25 percent of temperature reading, whichever is larger; Reproducibility - plus or minus 0.25 degrees; Response Time: Five seconds maximum for a 63 percent recovery; Operational Stability - Less than plus or minus 0.10 degrees F shift from initial calibration in one year; Interchange ability minus 0.5 degrees F or 0.25 percent of temperature reading, whichever is larger; Calibration: certified three point RTD calibration.

2.4.1.3 Transmitter

2.4.1.3.1 Type: Microprocessor based; Input- RTD wire; Element mounted with H.A.R.T. based digital communications capabilities.

2.4.1.3.2 Operation: Receive input signal from resistance temperature detector (RTDs), transmit a 4-20 mADC signal linearly proportional to the measured temperature and provide local indication. Capable of accepting 2, 3, or 4 wired RTD.

2.4.1.3.3 Functional: Output - 4-20 mADC linear with temperature; Power - Loop powered (12-45 vDC). Communications protocol - H.A.R.T.; integral zero and span adjustments; non-volatile memory; self-diagnostic capability.

2.4.1.3.4 Physical: NEMA 4 waterproof; Mounting - threaded connection on RTD well, same material as pipe; Local indicator calibrated in degrees F of span.

2.4.1.3.5 Performance: Calibrated Accuracy: plus or minus 0.25 percent of calibrated span or plus or minus 0.1 percent whichever is greater; Independent linearity: plus or minus 0.05 percent of calibrated span; Speed of response 0.5 seconds for 90 percent of a step change.

2.4.2 Temperature Switch

2.4.2.1 Type: Bulb and capillary. Suitable for direct measurement of gas inside a pipe.

2.4.2.2 Operation: To close an alarm circuit at high temperature.

2.4.2.3 Functional: Temperature element: flat copper coil, actuated by vapor pressure within the bulb; Range: -25 degrees Fahrenheit to 100 degrees Fahrenheit; 2 SPDT, contact rating: 5 amps at 120 VAC; Adjustment: external adjustment, with visible calibrated dial and visible on-off.

2.4.2.4 Physical; NEMA 4X, Size: 5-3/4-inch diameter steel case, with visible window on front case cover; Mounting: wall or pipe mounting brackets as shown on the Drawings;

2.5 PANEL DEVICES

2.5.1 Selector Switches and Pushbuttons

2.5.1.1 Type: Control devices shall be heavy-duty oil tight types with stackable contact blocks.

2.5.1.2 Functional: Provide contact arrangement and switching action as required for the control system specified.

2.5.1.3 Physical: For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide silver sliding contacts rated 5 amps at 125 VDC, for electronic (millivolt/ milliamp) switching provide contacts rated lamp at 28 VDC; Pushbuttons shall have flush type operators. Selector switches shall have knob or wing lever operators; NEMA rating - 4X; Provide legend plates denoting switch/pushbutton position/ function.

2.5.2 General Purpose Relays and Time Delays

2.5.2.1 Type: general purpose plug-in type.

2.5.2.2 Functional: Contact arrangement/function shall be as required to meet the specified control function; Mechanical life expectancy shall be in excess of 10 million; Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized; Solid state time delays shall be provided with polarity protection (DC units) and transient protection; Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

2.5.2.3 Physical: F or 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.

2.5.2.4 Options/Accessories Required: Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps; provide mounting rails/holders as required.

2.5.3 Intrinsically Safe Relays

2.5.3.1 Type: Relays shall be of the solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.

2.5.3.2 Options Required: Relays shall match power supply provided; relays shall be located in non-hazardous areas.

2.5.4 Intrinsic Safety Barriers (for 2-wire transmitter systems)

2.5.4.1 Intrinsic safety barriers shall be passive devices requiring no external voltage supply and supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.

2.5.4.2 Unit shall be Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).

2.5.5 24 VDC Power Supplies

2.5.5.1 Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.

2.5.5.1.1 The 24 VDC power supply shall meet the following requirements:

2.5.5.1.2 Input power: 115 VAC, +/- 10 percent, 60 Hz

2.5.5.1.3 Output voltage: 24 VDC

2.5.5.1.4 Output voltage adjustment: 5 percent

2.5.5.1.5 Line regulation: 0.05 percent for 10 volt line change

2.5.5.1.6 Load regulation: 0.15 percent no load to full load

2.5.5.1.7 Ripple: 3 mV RMS

2.5.5.1.8 Operating temperature: 32 to 140 degrees Fahrenheit

2.5.5.2 Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity. Provide a relay contact to indicate on/off status of the power supply.

2.5.5.3 Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

2.5.5.4 Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

2.6 ANALYTICAL INSTRUMENTS

2.6.1 pH Analyzer

2.6.1.1 Sensor

2.6.1.1.1 Type: pH-sensitive glass membrane electrode, double or triple-junction reference electrode and ground electrode with integral preamplifier; For submersion or flow-through application as indicated on the Drawings.

2.6.1.1.2 Function/Performance: Range: 0 to 14 pH; Temperature Compensation: Temperature element integral to sensor for temperature compensation.

2.6.1.1.3 Physical: Flat glass or shrouded pH electrode; Sensor assembly constructed of PVDF, Tefzel, or similar material; Sealed electrodes.

2.6.1.1.4 Accessories Required: Manufacturer's cable for connection of sensor to transmitter. Length as required by installation indicated on drawings; One years supply of consumables for calibration; Handrail mounting kit where indicated on the Drawings to be required.

2.6.1.2 Transmitter

2.6.1.2.1 Type: Micro processor based, intelligent transmitter compatible with sensor provided.

2.6.1.2.2 Function/Performance: Accuracy (including sensor): Plus/minus 0.05 pH; Repeatability (including sensor): Plus/minus 0.01 pH; Range: 0 to 14 pH; Environmental conditions: 0 to 55 ^{0}C and 5 to 95 relative humidity; Output: One 4-20 mA output adjustable over the range of 1 to 14 pH. Two alarm contacts rated 5 A at 230 VAC, configurable over the output range; Temperature Compensation: Compensation over a temperature range of 0 to 85 ^{0}C; Diagnostics: On screen instructions and display of self diagnostics; Display: Digital indicator displaying pH.

2.6.1.2.3 Physical: Transmitter shall be suitable for surface or pipe stand mounting; Enclosure shall be NEMA 4X (IP65); A/C power supply will be as specified in SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

2.6.2 Chlorine Residual Analyzer

2.6.2.1 Type: Microprocessor based electronic transmitter/converter a flow through sample cell. Measures free chlorine. Analyzer to be configured or specified for free chlorine. Utilizes amperometric methods.

2.6.2.2 Function/Performance: Accuracy: plus or minus 1 percent of full scale or 0.002 mg/l, whichever is greater, below 20 mg/l; plus or minus 5 percent of reading between 20 and 50 mg/l. Resolution: 0.001 mg/l (<10 mg/l) and 0.01 mg/l (10 to 20 mg/l). Range: 0-50 mg/l. Environmental Conditions: The instrument shall operate over an ambient temperature range of 2-50 degrees C. Output: Isolated 4-20 mA output and 3 programmable alarm contacts rated for 5A at 230 VAC. Display: Dot matrix or LCD type displaying chlorine residual in ppm. Temperature Compensation: Compensated for sample temperatures over the temperature range of the instrument. Diagnostics: On screen instructions and self diagnostics. Response: 90 percent of full scale within 2 minutes.

2.6.2.3 Physical: Analyzers shall be suitable for surface mounting. Power Requirements: 120 VAC/60 Hz. Electronics enclosure shall be NEMA 4X. Sensor shall have three electrodes and shall have an automatic cleaning mechanism.

2.6.2.4 Accessories Required: Provide one year's supply of consumables and one spare electrode.

PART 3 EXECUTION

3.1 GENERAL

See execution requirements specified in SECTION 13300 – GROUNDWATER TREATMENT SYSTEM.

END OF SECTION

SECTION 13410

SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Refer to SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

1.1.2 The Contractor shall furnish all labor, materials, equipment, services and incidentals required to install and place into operation a computer-based monitoring and control system for the ground water treatment facility (GWTF). The system shall consist of Programmable Logic Controller (PLC) based control system for process interface and data acquisition for the treatment facility.

1.1.3 Provide a free-standing NEMA 4X GWTF Panel to house the PLC and associated components including an Operator Interface Terminal (OIT). The panel shall communicate with its own alarm/report printer. The panel shall be 72 inches high by 37 inches wide and have a depth of 24 inches.

1.1.4 Provide one laptop and stand to program the PLCs. Laptop computer, software, and accessories shall become the property of the government upon the completion of Contract. Laptop computer shall be in full working order, as specified and required for GWTF operation, and all software and accessories shall be complete upon transfer to government; otherwise, such items shall be replaced at the Contractor's expense.

1.1.5 Provide one autodialer connected to the PLC at the GWTF Panel via a RS-232C serial connection.

1.1.6 Provide one uninterruptible power supply (UPS) for the GWTF Panel and components.

1.1.7 High speed broadband service for remote programming by the laptop shall be installed in accordance with SECTION 16742 - HIGH SPEED BROADBAND SERVICE.

1.2 SUBMITTALS

Refer to SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

1.3 REFERENCE STANDARDS

Refer to SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

1.4 QUALITY ASSURANCE

Refer to SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

1.5 DELIVERY, STORAGE AND HANDLING

Refer to SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

1.6 DESCRIPTION OF SYSTEM

The following points are not intended to be a comprehensive list of the system's features, only a summary of the major functions of the system. The computer based monitoring and control system specified herein shall perform the following generalized functions.

1.6.1 Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.

1.6. 2 Collect and store accurate, reliable operating information for present and future uses.

1.6. 3 Assist plant-operating personnel by recording and communicating off-normal operating conditions and equipment failures.

1.6. 4 Accumulate and store equipment running times for use in preventative maintenance.

1.6. 5 Provide color graphic displays and summary reports for use by the plant operating and supervisory personnel.

1.6. 6 Provide trending for all analog values.

1.6. 7 Provide control system diagnostics.

1.6.2 The system shall include the following:

1.6.2.1 Process level PLCs with I/O, network communications, and other capabilities as specified herein and shown on the Contract Drawings.

1.6.2.2 Flat screen display OITs installed integrally in each panel.

1.6.2.3 Computer operating system, OIT control/graphic software, PLC programming software, and other application software as specified herein.

PART 2 PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLER

2.1.1 A PLC shall be furnished to communicate to field mounted transducers, switches, controllers and process actuators. Communications protocol shall be completely transparent to process operators. The PLC shall be an intelligent device that can collect data and process control functions, can be remotely programmed from a central station, and can be locally programmed from a portable programmer.

2.1.1.1 The PLC shall be a microprocessor based device and shall be furnished with a power supply, processor, communications interface, and process input and output modules.

2.1.1.2 The unit shall be capable of handling the required number of process inputs and outputs as tabulated on the Contract Drawings and I/O list, plus 20 percent active spares.

2.1.1.3 In addition to the number of input and outputs the processor can accommodate, the processor shall be sized to handle the control strategies specified in SECTION 13300 - GROUNDWATER TREATMENT SYSTEM and otherwise required. The processor shall be loaded to no more than 65 percent of capacity.

2.1.1.4 The PLC processor shall be capable of stand-alone operation in the event of communication link failure.

2.1.2 The PLC modules shall be housed in the NEMA 4X cabinet, which shall be provided with an internal recirculating fan to reduce localized heat buildup on the circuit cards.

2.1.2.1 The process interface units shall be provided with screw type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 12 AWG wire. All terminals shall be provided with unique identification in accordance with approved loop interconnection diagrams. The cabinet shall have a print pocket on the inside of the door, suitable for storage of interconnection diagrams for the cabinet.

2.1.2.2 Power provided to the PLC cabinet shall be standard, commercial 120 VAC, single phase, 60 Hz.

2.1.3 The process interface modules shall be capable of accepting switch contacts, solid state switch and high-level logic inputs; 4-20 mADC analog inputs; and shall provide momentary and latched contact outputs; and 4-20 mADC analog outputs as required.

2.1.3.1 The discrete inputs shall provide power to field dry contacts. Contact inputs shall be optically isolated. All discrete input modules shall be 120 VAC input cards. Each input circuit shall be individually isolated and shall be designed to withstand transients and surges without damage. Input components shall be individually fused so that failure within one component will not interrupt processing of others. Input circuits shall be tested to IEEE Standard C37.90 surge withstand capability. Maximum number of inputs per card shall be 16.

2.1.3.1.1 The station microprocessor shall convert contact inputs into minimum 16-bit data words.

2.1.3.1.2 Light emitting diodes located on the PLC input modules shall be provided to indicate a CLOSED Contact, CONDUCTING transistor switch, a LOW positive logic level, or ac line voltage ON conditions.

2.1.3.2 The discrete outputs shall be capable of providing relay dry-contact outputs in either momentary (pulsed), or latched (sustained) mode to control 120 VAC powered loads.

2.1.3.2.1 All AC output circuits shall include fuses. Dry contact output contacts shall be rated 5 Amps at 120 VAC minimum. Outputs shall be individually isolated. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed in the non-conducting mode, or remain as were prior to failure. Isolation resistance shall be 1000 ohms minimum at 300 VDC between any set of field terminals and any other set or earth ground. Isolation voltage shall be 500 VAC RMS minimum between any set of field terminals and any other set or earth ground. Light-emitting diode type of status indication shall be provided on the PLC output modules. Maximum number of outputs per card shall be 16.

2.1.3.3 The analog inputs shall accept 4-20 mADC differential inputs from field mounted transmitters. Common mode input protection of 30 VDC minimum shall be provided. All analog input signals shall be individually isolated; no single ended or common signals are allowed. Maximum number of inputs per card shall be 8.

2.1.3.3.1 Input signal conversion shall be a minimum of 12-bit word (11-data bits plus 1-sign bit).

2.1.3.3.2 Input accuracy shall be 0.1 percent of full scales span. The station shall also be capable of providing dc power for the field transmitters as required.

2.1.3.4 Analog outputs shall convert 12-bit (11-data bits plus one-sign bit) data words into proportional, isolated 4-20 mADC analog output signal to adjust set points of local process controllers, pump speed and valve position. Output load drive capability shall be 750 ohms minimum for each output. Each analog output shall be individually isolated. Accuracy shall be 0.1 percent of full scale output span. Maximum number of outputs per card shall be 8.

2.1.3.4.1 Response to station or communication system failure shall be selectable such that upon failure the output shall either remain at the last value, or go to zero (4 mA), as required by the process.

2.2 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEMS

2.2.1 The UPS system shall sustain operation of the indicated equipment and shall provide power for an orderly shutdown to prevent the loss of the System during power failure and shall provide isolation between the following listed components and the plant power system. The UPS shall sustain operation for the PLCs, autodialers, OITs and related equipment.

2.2. 1.1 The UPS shall be a continuous-duty, on-line, solid state, dual conversion, single-phase uninterruptible power system.

2.2.2 Under normal conditions incoming AC power is rectified to DC power to supply the internal DC bus of the UPS. The output inverter takes the DC power and produces regulated AC power to supply the critical load. The batteries attached to the DC bus are float charged during normal operation.

2.2.3 The UPS system shall be sized by the Contractor to sustain the connected full load for a minimum period of 30 minutes and half load for 60 minutes in an operating environment of 50 Degrees Fahrenheit to 120 Degrees Fahrenheit.

2.2.3.1 The UPS system shall be lightning and surge tested per ANSI/IEEE C62.41 and shall be capable of reducing an input spike to less than 3 volts on the output for a 2000 to 1 spike attenuation. The UPS system shall have 120 dB common mode and 60 dB Transverse mode noise attenuation.

2.2.3.2 The UPS system shall provide a true separately derived power source as defined in the NEC article 250-5d with output neutral bonded to ground. There shall be no direct connection between input and output and less than 2 pf of effective input to output capacitance.

2.2.3.3 Input power to the UPS system shall be 120 VAC, single phase. The UPS system output shall be regulated to 120 VAC $\pm$ 3%, 60 Hz $\pm$ 0.5 Hz over the full dynamic range from no load to full load and low line VAC to high line VAC and low battery voltage to high battery voltage. The system shall be hardwired to the panel. No cord/plug types will be allowed.

2.2.3.4 The UPS system shall provide computer grade sine wave power with 5 percent or less total harmonic distortion.

2.2.3.5 The UPS system capacity shall be rated in volt-amperes (VA) while loaded with typical computer grade switch mode power supplies having a power factor of 0.6 to 0.7 and crest factor of 2.7 to 3.5. Capacity shall be as required to meet the load requirements plus a minimum of 25% additional capacity.

2.2.3.6 The UPS system shall have an efficiency of at least 90% when operated from AC line.

2.2.3.7 The UPS system shall have built-in self-diagnostic monitoring capable of monitoring as a minimum AC volts in/out, AC current in/out, battery voltage, VA load, watts, power factor percent of full load, time of day, system hours, inverter hours and projected run time available.

2.2.3.8 Each unit shall have two normally open relay contacts for remote alarm condition reporting. All available status contacts shall be connected to the control system.

2.2.3.9 The UPS system shall have a dual track redundant configuration that utilizes either line or inverter output for power and shall be designed to meet or exceed a Mean Time Between Failure (MTBF) of 100,000 hours.

2.2.3.10 All cables and connectors for power distribution to the system components shall be furnished and installed under this Contract. The UPS shall come furnished with an external bypass switch.

2.2.3.11 The Contractor's packaged groundwater treatment system vendor and the vendor's process control system supplier shall coordinate the input voltage and neutral requirements with the electrical requirements before ordering the UPS.

2.2.3.12 The system batteries shall be sealed, no maintenance type rated for 100-amp hour at 12 VDC. The system batteries shall be mounted internally to the UPS cabinet.

2.2.3.13 The UPS shall be installed in a non-permanent manner so that it may be moved to provide the necessary clearances for maintenance and servicing.

2.2.3.14 The Contractor shall provide test data on the UPS to show conformance with these specifications including, but not limited to, full load back-up time, half load back-up time, efficiency at full load, output voltage/frequency regulation during adverse input power conditions, etc.

2.2.3.15 The UPS shall come equipped with dry contacts to provide status of low battery and bypass status.

2.3 COMPUTER BASED CONTROL SYSTEM

2.3.1 General

Provide fully configured Operator Interface Terminals (OIT) systems including computer hardware, peripherals, operating software, application software, and configuration as specified herein. All computer hardware and software shall be Windows XP compatible, certified by Microsoft Corporation.

2.3.2 OIT Industrial Computers

2.3.2.1 The industrial OIT shall be a 15 inch touch screen model with a TFT color display and ports to connect a keyboard and mouse. The unit shall have the following features: Intel Pentium 4 2 GHz processor; 512 MB SDRAM; PCI controller; 80 GB hard drive; DVD ROM/CD-RW Drive; Windows XP software with the latest Service Pack; 1.44mb 3.5 inch floppy diskette drive; and watchdog and temperature monitor.

2.3.2.2 The industrial OIT shall be equipped with the following communication features: one serial port, one parallel port, 2 USB 1.1 ports, 1 VGA port, and one 10/100 Mbit/s Ethernet port.

2.3.2.3 The industrial OIT shall be rated NEMA 4X and mounted on the front of the GWTF Panel.

2.3.3 Color Printer

2.3.3.1 The color printer shall be a laser color printer capable of automatic or manual printing of color or black and white graphics and text on letter media. The printer shall be capable of printing on standard bond paper, glossy paper and transparency film.

2.3.3.2 The printer shall be capable of printing color graphics and black text only at minimum speeds of 8 pages per minute for letter size media. The printer shall be rated for medium duty.

2.3.3.3 The printer shall have separate black ink cartridge for black text printing.

2.3.3.4 The printer shall have an automatic paper-out sensing mechanism, which shall stop the print operation then notify the host computer and the operator to prevent loss of printable information.

2.3.3.5 The printer shall operate on 120 VAC $\pm$ 10% 49.5 to 60.5 HZ in an environment of 20 to 80% RH non-condensing. The printer shall be UL listed and CSA certified.

2.3.3.6 The printer shall be supplied with an Ethernet interface.

2.3.3.7 The printer shall print at 600 x 600 DPI color resolution, shall be provided with 20 mb of RAM, and shall be 100 percent postscript compatible.

2.4 LAPTOP COMPUTER

2.4.1 A laptop computer and stand shall be provided for use in communicating with the PLC for programming and troubleshooting. The computer shall have, at a minimum: Intel Pentium IV 2.8 GHz processor, 1024 MB SDRAM (expandable), 80 GB Hard Drive, 3.5-inch disk drive, internal DVD/CD-RW drive with software, 14.1" XGA TFT Display, 512 MB RAM graphics card, 53WHr Lithium-Ion Battery, serial and parallel ports, and a 56K modem. The computer shall be provided with an IEEE-802.3 10/100 Ethernet and a USB 2.0 communication ports. The computer shall be supplied with Microsoft Windows XP with the latest Service Pack installed, docking station and carrying case, and a 4-year next business day on-site warranty. The Contractor shall provide this computer, software, communication cable to PLC, and all required software to perform the functions as indicated and as specified herein.

2.4.2 The laptop computer shall be supplied with a portable stand. The stand shall have a steel top and steel tripod, rubber spiked feet, and carrying case. The stand shall be inStand Model CR5 or equal as approved by the Engineer.

2.5 PLC SYSTEM SOFTWARE

2.5.1 General Requirements

2.5.1.1 Software shall be modular, comprised of an integrated group of proven, standard software modules.

2.5.1.2 All of the programs are to be generalized in nature such that new functions may be added later. Integration of future application programs and the servicing of their input and output requirements, including construction of new printing formats and other system interfaces, shall be accomplished without recompiling of application software.

2.5.1.3 Changes in process parameters, addition and deletion of process schemes or equipment, and addition or modification of CRT graphic displays and printed report formats shall be via the use of process operator and control engineer oriented icons, graphics, and menus organized in a hierarchical fashion.

2.5.1.4 System parameters such as: date, time, set points, alarm limits, PID tuning constants, etc., shall be entered or modified via the OIT/laptop. Any input, which modifies the system, shall be logged on the logging printer and a historical disk file with date, new value, and previous value.

2.5.2 Operating System Software

2.5.2.1 The operating system software shall provide system resource allocation and management in a pseudo real-time environment. Both program development and on-line monitoring and control programs shall execute concurrently under predetermined priority assignments. The Operating System shall control storage allocation and program movement; program scheduling; monitoring of system security timers; and interrupt processing for internal and external events such as Input/Output transfer completion, real-time program initiation, and detection of abnormal system conditions.

2.5.2.2 The operating system shall provide automatic start-up of the system, including processor and network communication, and all application software functions, upon initial power up or restoration of power after a power failure without operator intervention.

2.5.2.3 Provide operating system to monitor and control the execution of all programs; handle job initiation and termination requests; monitor program requests for system service; accept job control statements, operator commands, and translate them into actions; respond to and report error conditions relating to program processing.

2.5.2.4 Process Input/Output Handler: Process Input/Output routines shall be main memory resident, and shall provide interface to programs, process measurements and control system, and perform "reads" and "writes" and monitor device status.

2.5.2.5 Security: Provide operating system with provisions for password protection and security access to files and programs. On log-off, access to all computer functions shall be inhibited including boot-access via floppy diskettes. Configure the system and develop file structure for three user types initially.

2.5.2.5.1 System Administrator: Full access to system.

2.5.2.5.2 Engineer/Supervisor: Full access to all OIT and control system variables, databases, and programs. Restrict access to system parameters.

2.5.2.5.3 Operator: Read access to all OIT and control system variables, databases, and programs. Full access to treatment plant operating functions including reports, control setpoints, manual overrides, alarm acknowledgment, etc.

2.5.2.6 Provide Microsoft Windows XP with the latest Service Packs as recommended by the OIT software manufacturer. Provide Microsoft Remote Access Service for remote access of the OIT.

2.5.3 Support Software

2.5.3.1 Provide the latest version of Microsoft Office Professional for Windows for the computer system.

2.5.3.2 Provide an original CD version with licenses for the computer system.

2.5.3.3 Provide the latest version of anti-virus software and firewall protection.

2.5.4 Provide PLC program development software system

2.5.4.1 The Contractor shall provide as part of the System a software package with one license to allow off-line or on-line ladder logic program development, annotation and monitoring on a Pentium based personal computer operating under the computer operating system specified herein.

2.5.4.2 The software shall be utilized for development of the ladder logic programs and transfer to the PLC.

2.5.4.3 The software package shall be completely menu driven and shall be distributed on standard CD-ROM media.

2.5.4.4 The software package shall include a software license agreement allowing the EPA the rights to utilize the software as required for any current or future modification, documentation, or development of the PLC's furnished for this project.

2.5.4.5 The software shall provide as a minimum the following functions:

2.5.4.5.1 Annotation of all ladder elements with at least 3 lines of 6 characters each.

2.5.4.5.2 Annotation of all ladder rungs with at least 240 characters.

2.5.4.5.3 Provide visual "power flow" monitoring of circuit elements (when connected to the PLC).

2.5.4.5.4 Provide annotated ladder diagram printout on laser printer supplied under this Contract for documentation purposes.

2.5.4.5.5 On-line help facility.

2.5.4.5.6 Download or upload ladder program from the PLC to the PC.

2.5.4.5.7 Provide a ladder element and I/O cross-reference table.

2.5.4.5.8 Provide all monitoring, forcing, programming error detection, searching, configuration, etc., functions as required to allow an operator/programmer to completely program the PLC.

2.5.4.6 Development software shall be the latest version of IEC 1131 standards software. Software shall be suitable for simultaneous operation with the computer based control system software specified herein. Provide means for development software operation without affecting on-line operation of the computer control system.

2.6 ALARM DIALER

2.6.1 The dialer shall be a solid state component capable of dialing from one to eight phone numbers, each up to 16 digits in length. Phone numbers are to be entered by the system's keyboard. Standard pulse dialing or Touch Tone Dual Tone Multi Frequency (DTMF) dialing shall be selected at the keyboard.

2.6.2 The user may optionally elect to alter the following parameters from their default values via keyboard entry. The built-in voice will guide and confirm the following programmable features: user programmable speech; remote programming; alarm response delay; delay between alarm call outs; alarm reset time; incoming ring response (answer) delay; number of message repetitions; station ID number; input alarm criteria; autocall test; run time meter.

2.6.3 User-entered programming shall be kept intact even when all power is removed for up to ten years.

2.6.4 Acknowledgment of an alarm phone call is to be accomplished be pressing a Touch Tone button as the alarm call is being received, and/or by returning a phone call to the unit after receiving an alarm call, at the user's choice.

2.6.5 The autodialer is to communicate via a highly intelligible solid state voice synthesizer (magnetic tape loops will not be used) with an identification of its location and the specific alarm condition(s) that exist.

2.6.6 The unit shall continuously monitor the presence of AC power and the status of four contact closure inputs. AC power failure, or violation of the alarm criteria at any input, shall cause the unit to go into alarm status and begin dial-outs.

2.6.7 Upon initiating an alarm phone call, the system is to "speak" only those channels that are currently in "alarm status."

2.6.8 Inquiry phone calls can be made directly to the unit at any time from any telephone, locally or long distance, for a complete status report of all variables being monitored, including power status. Further, by pressing the Touch Tone button, the user may hear all user-entered programming and diagnostic counts. All this information shall be available by keyboard inquiry at the unit as well.

2.6.9 Normal power shall be 105-135 VAC, 15 watts maximum. The product is to contain its own gel cell rechargeable battery which is automatically kept charged when AC power is present. The battery is to be capable of keeping the product operating, and user programming intact, for a minimum of six continuous hours in the event of power failure. The built-in charger shall be precision voltage controlled, not a "trickle charger" to minimize recharge time and maximize battery life available.

2.6.10 The autodialer is to operate on a standard rotary pulse or Touch Tone "dial-up" phone line and is to be F.C.C. approved. A regular private line is to be provided. Connection to the telephone is through an industry standard 4-pin modular jack (RJ-11).

2.6.11 Gas tube and solid state surge protection is to be provided on all inputs, including power, phone and signal lines. These protectors are to be integrally incorporated into the main circuit board for maximum protection. The installer shall provide a good electrical ground connection point near the unit to maximize the effectiveness of the surge protection.

2.6.12 The unit shall be covered by a two (2) year warranty covering parts and labor performed at the factory.

2.6.13 The unit shall communicate to the PLC via an RS-232C serial connection. The cable shall be standard RS-232C copper cable.

2.6.14 All keyboard and front panel switches shall be sealed to prevent contamination. Front panel LED's shall indicate: Normal Operation; Program Mode; Phone Call in Progress; Unacknowledged Alarm; Acknowledged Alarm; AC Power Present; AC Power Failure; Low or Discharging or Recharging Battery. On any Inquiry telephone or On-Site status check, the voice shall provide specific warning if no dialout phone numbers are entered, or if the alarm switch is in the "disable" position, or if AC power is off or has been off since last reset. A built-in microphone shall allow anyone at a remote phone to listen to local sounds and to have a two-way conversation with personnel at the dialer.

2.6.15 The unit shall be mounted in the GWTF Panel.

2.7 PROCESS CONTROL SOFTWARE (OIT SOFTWARE)

2.7.1 General

2.7.1.1 The OIT software shall exhibit strong compliance with Microsoft's Windows Open Systems Architecture (WOSA) standards, such as in its use of dialog boxes and menus.

2.7.1.2 The OIT software shall support running as a service under the Windows XP operating system, making it independent of the XP user login limitations.

2.7.1.3 The OIT software shall provide a mechanism for accepting configuration input either directly from the keyboard, via a mouse, or as appropriate, indirectly through ASCII files that are created by an external text editor or relational database program.

2.7.1.4 Source code modifications, re-assembly or recompilation shall not be required for implementing user-level system changes.

2.7.1.5 All configuration changes shall be capable of being made on-line, while the OIT software is operating. Data definitions, operator displays, etc. shall be capable of being modified, added or deleted without having to interrupt the data acquisition.

2.7.1.6 The OIT software shall include complete user documentation, including examples of how to operate the various modules within the system.

2.7.1.7 The documentation shall be in electronic format, HTML based with the ability to search for topics by keyword or search for specific text.

2.7.1.8 The OIT software shall include a help facility that is capable of being invoked on-line through a point-and-click operation and shall be based upon Windows standard Hypertext, and shall provide useful, context-sensitive information on the operation of the package.

2.7.1.9 The help utility shall also support the ability to perform full text word search, add custom comments, bookmark topics, copy and paste into another application, print, and use of fonts and colors.

2.7.1.10 The OIT software shall be able to display data from and write values directly to other nodes without the need to duplicate the data in the local system.

2.7.1.11 Configurations that are not attached to I/O and do not contain tags shall also be available. The OIT software shall have two types of rights available, controlled by the developer using security, to a tag:

- Right to read and write to tags in other nodes
- Right to only read tags from other nodes

2.7.1.12 The process control software package shall be the latest version of vendor's standard OIT software.

2.7.1.13 All copies of the software shall be full developmental licenses.

2.7.2 Data Handling Capabilities

2.7.2.1 General

2.7.2.1.1 No programming, compiling or linking shall be required to configure the OIT software.

2.7.2.1.2 The database tags shall be configurable on-line. That is, new function and database tag assignments can be added while the OIT software is performing data acquisition and control operations.

2.7.2.1.3 The process database containing the current value of the data, or tag list, shall be memory-resident and of a design that is appropriate for real-time monitoring and control functions. Its design shall be optimized for speed, memory usage, and data integrity and system security. Floating-point arithmetic shall be used in all calculations.

2.7.2.1.4 This database shall be stored as a standard Windows file on the local or network hard disk and, upon starting the OIT software, this database is loaded into the computer's memory.

2.7.2.1.5 Only computers physically connected to process equipment shall require a database.

2.7.2.2 Data Integrity

2.7.2.2.1 The software shall provide pre-emptive multitasking to ensure that common Windows actions do not interfere with I/O communications, processing of data, alarming, and the integrity of the real-time and historical data.

2.7.2.2.2 The software shall be written fully 32-bit compliant so that it runs native in the Windows XP operating system. Emulation using 16-bit software code is not permitted.

2.7.2.3 Database Tag Configuration

2.7.2.3.1 Various input/output hardware assignments, as well as processing functions, shall be assigned to named tags or "function blocks". Multiple tags can be tied together to perform more complex functions.

2.7.2.3.2 During the configuration process, the program shall be capable of checking the tag structures for correct linkages, appropriate names, and so on.

2.7.2.3.3 The package shall allow for database configuration verification. This task will allow for verification of configuration errors on a local database or a database on another node. The scan processing program shall be capable of detecting and handling configuration errors at run-time. Errors shall be reported in a dialog box and a user shall be able to make the corrections from this dialog box.

2.7.2.3.4 The database shall allow for editing from a graphic editor, from within the building of a graphic operator screen, or from within a VBA script. The database editing shall be able to be accessed locally or across the network. A node can edit a database on another node while online.

2.7.2.4 Database Tag Types

2.7.2.4.1 Analog Input: This reads an analog value (time, temperature, speed, pressure, level, etc.) either directly from an A/D converter or from a register within an I/O device such as a programmable controller, and automatically scales the raw data to engineering units (seconds, revolutions/minute, pounds/sq. in., degrees, etc.)

2.7.2.4.2 Analog Output: This writes an analog value (setpoint, output, speed, etc.) either directly to a D/A converter or to a register within an I/O device, such as a programmable controller.

2.7.2.4.3 Analog Register: This accesses multiple analog I/O points for read or write functions with a single I/O tag. The number of addresses is dependent upon the I/O device used.

2.7.2.4.4 Boolean Logic: This tag-type takes up to eight (8) inputs, typically logical or digital values, and performs Boolean arithmetic on them. The result can then be passed to or used by other tags or applications within the OIT software. The operators shall include:

- OR
- AND
- EQUAL
- NOT EQUAL
- NOT
- XOR
- NAND
- Parentheses

2.7.2.4.5 Calculation: This tag-type takes up to 8 variables or constants and performs an arithmetic calculation on them. The result can then be passed to or used by other tags or applications within the OIT software. The operators shall include:

- Add
- Subtract
- Multiply
- Divide
- Parentheses
- Absolute value
- Square root
- Exponentiation
- Natural log
- Base-10 log
- Relational operations (greater than, less than)
- Change floating point values to integers

2.7.2.4.6 Digital Input: This senses the logical on/off state of a switch, relay, pushbutton, etc. either directly from the I/O hardware or from a bit within the memory of an I/O device, such as a programmable controller. The value shall be displayed in a user-selected format (0/1, open/close, false/true, etc.) A Digital Input tag shall also support write outs.

2.7.2.4.7 Digital Output: This sets a logical on/off state in an output relay either directly in the I/O hardware or in a bit within the memory of an I/O device, such as a programmable controller. The value shall be accepted in a user-selected format (0/1, open/close, false/true, etc.) The Digital Output tag shall also provide output-reverse handling and the ability to specify an initial cold-start position.

2.7.2.4.8 Digital Register: This accesses multiple digital I/O points for read or write functions with a single I/O tag. The number of addresses is dependent upon the I/O device used.

2.7.2.4.9 Event Action: This tag-type monitors the value or alarm conditions of an I/O point and, based upon TRUE/FALSE conditions, performs one of two operations. These operations include starting or stopping the processing of another tag or opening or closing a digital point.

2.7.2.4.10 Program: This function provides the user with a procedural language for sequencing, monitoring, and controlling typical process operations, including:

- If/Then go to another step
- Wait until a process condition occurs
- If time-out go to another step
- Go to another step
- Set a tag to a value or the value of another tag
- Open/Close a digital tag
- Set Auto/Manual status of a tag
- Set On Scan/Off Scan status of a tag
- Add/Subtract a value to/from a tag
- Print a message
- Call other program blocks as subroutines
- Run other program blocks in parallel
- Stop other program blocks
- Pause or delay a number of seconds
- Play a .WAV sound file
- Run an executable program

The current step being processed shall be capable of being displayed on the operator's OIT/laptop. In addition, a debug mode shall be provided to facilitate program checkout.

2.7.2.4.11 Timer: This tag performs a counting operation. It counts in either the up or down direction, from a pre-set value to a target value. Upon reaching the target or time-out condition, a contact may be closed. This tag also supports conditional next block processing. It shall time up to one (1) year. The timer may be started, stopped, reset or resumed based on a sensed condition or operator command.

2.7.2.4.12 Totalizer: This tag-type maintains a floating point total for values passed to it from other database tags.

2.7.2.5 Tag Attributes

2.7.2.5.1 The OIT software shall support databases tags that are up to 30 alphanumeric characters in length. All other application programs will use this tagname as their sole reference to the data element assigned.

2.7.2.5.2 For tags assigned to actual hardware points, they shall also contain fields for the following:

- Hardware device name
- Hardware address
- Hardware specific parameters
- Signal conditioning requirements

2.7.2.5.3 Simulation tags shall be created which receive their values from the operator's keyboard, other internal calculations, or other programs.

2.7.2.5.4 Tags shall be processed periodically, with the fastest scan rate being fifty (50) milliseconds. Scan rates shall be able to be set independently for each appropriate tag. Longer scan rates of up to once per twenty-four (24) hours shall also be supported. A mechanism for load-leveling, or phasing, the time-based processing of tags is also required. The default scan rate shall be one (1) second.

2.7.2.5.5 All tags shall have a description field.

2.7.2.5.6 Each tag associated with a hardware address or capable of causing an alarm condition shall have a means of displaying a descriptive message on the alarm printer. The descriptor shall be at least 40 characters in length.

2.7.2.5.7 Any output or control block shall be able to log a "time stamp" when an operator changes a value.

2.7.3 I/O Device Communications

2.7.3.1 Devices

2.7.3.1.1 The OIT software shall support communication, as a minimum, to the following external input/output (I/O) devices:

Programmable logic controllers (PLCs – interfaced via serial communications, PLC vendor-supplied interface cards, or standard Ethernet communications):

- Distributed control systems (DCS)
- Analog-to-digital converters
- Remote I/O
- OPC Servers
- Ethernet Communications

2.7.3.2 Driver Configuration

2.7.3.2.1 The communications driver shall be configurable on-line

2.7.3.2.2 The block sizes and poll times shall be individually adjustable by the user. Supported block transfer times vary depending upon the I/O device, but shall be able to run as fast as the I/O device can transfer data.

2.7.3.2.3 For serial or complex devices, the configuration process shall be interactive and use menus to select:

- Baud rate (if applicable)
- Reply time-out time (with 0.1 second resolution)
- Station address of device (if applicable)
- Block transfer base address and size (if applicable)
- Block interrogation rate

2.7.3.2.4 The use of Microsoft Windows Dynamic Data Exchange (DDE) for device communications shall be supported by the vendor. An OPC Server will be used for PLC communication.

2.7.3.2.5 The device communications program will perform error checking on messages such as lost response (time-out) and data error (checksum, LRC, CRC, etc.).

2.7.3.2.6 If communications errors were detected, the software shall automatically indicate that the data (on graphic displays, in historical files, etc.) is no longer valid. The invalid data should be replaced with a user defined character. The OIT software shall automatically attempt to re-establish communications, and, if successful, shall then replace the characters with valid data. These capabilities shall be built-in to the software and shall not require any user programming or other actions to implement.

2.7.3.2.7 Failover to a user-configurable back-up port shall be provided as a standard function of the driver.

2.7.3.2.8 In addition to I/O drivers, the process database shall be able to send and receive data with an OLE for Process Control (OPC) server. Any database block should be able to receive or send OPC data by supplying an OPC address. The OIT software shall also be capable of serving OPC information to any OPC complaint database.

2.7.3.2.9 The OIT software shall provide a diagnostic program capable of running on-line or off-line that can monitor message rates from the communication program.

2.7.3.2.10 The diagnostic will display the number of new messages, retries, time-outs, any occurrences of error, and the specific error code.

2.7.4 Software Tools

2.7.4.1 The OIT software shall be built on and use industry standard development tools.

2.7.4.2 Data Access

2.7.4.2.1 The OIT software shall provide an open architecture that allows interaction with other programs. It shall provide a mechanism for other programs to access individual data elements and fields within data elements in real time. File transfer mechanisms are not acceptable; the access shall be direct to the memory-resident database.

2.7.4.2.2 The following shall be supported:

2.7.4.2.2.1 ODBC: The OIT software shall support Open Database Connectivity (ODBC) for sharing data from its database to any other ODBC complaint database through SQL queries, via an ODBC dynamic-link library (DLL) driver. At a minimum the database shall support communication to Microsoft Access, SQL Server, and Oracle.

2.7.4.2.2.2 OLE for Process Control (OPC): The OIT software shall be both an OPC client for communicating to any OPC complaint server as well as an OPC server to serve data to any OPC complaint client.

2.7.4.2.2.3 Visual Basic for Applications (VBA): The OIT software shall have VBA embedded as part of the development environment. VBA support will be used for pre built scripts & custom scripts. It shall also support search and replace and the ability to copy all forms modules and scripts from one object to the next.

2.7.4.2.2.4 OCX or ActiveX: The OIT software shall support the ability to have any third party OCX (ActiveX control) placed into its container. All third party controls shall have the right to behave like any object created by the OIT software. Also the OIT software shall contain any bad or misbehaving OCX or ActiveX control and be able to shutdown the control without shutting down the graphic picture, system, or Node.

2.7.4.2.2.5 DDE: The OIT software shall support Microsoft standard Dynamic Data Exchange (DDE) Server and Client functionality to share data with other DDE-aware applications.

2.7.5 Graphics Capabilities

2.7.5.1 General

2.7.5.1.1 The graphics package shall provide a means of creating and displaying color object-oriented graphic displays that will be used by the operator to monitor and control the process. Real-time values being read from the field devices shall be capable of being displayed in a variety of user-configurable formats.

2.7.5.1.2 Graphic displays shall be standard Microsoft Windows files and shall be able to be stored on the OIT software disk, a floppy diskette, virtual (RAM) disk or file server, based on user-entered selections. There shall be no limit (other than physical disk size) to the number of displays that can be developed and accessed on-line.

2.7.5.1.3 The development and runtime graphics packages shall both be multi-document architecture applications.

2.7.5.1.4 Support for displays larger than the size of the monitor shall be provided. If used, scroll bars shall be provided to allow the user to move to other areas of the display.

2.7.5.1.5 The graphic screens shall be based on objects and not individual pixels. The object graphics will consist of an image and image attributes, such as size, color, and position that will define the properties of the object. The user will use tools; menus and dialog boxes to change object properties. An object is defined as anything that can be created with drawing tools from within the package or an image imported into the package. All properties, events, and methods of the object shall be exposed to the OIT software.

2.7.5.2 Graphic Creation

2.7.5.2.1 The OIT software shall provide an interactive object-oriented editor or workspace that allows creation of graphic displays using a mouse.

2.7.5.2.2 The OIT software shall include a utility to quickly toggle, via a mouse click or hot-key, between the graphic building and graphic runtime modes to speed display animation verification during the development process.

2.7.5.2.3 The software shall be designed with the ability to make changes to the graphics while the software is running. Shutting down the system shall not be required to make changes.

2.7.5.2.4 A properties window, exposing all properties for an object shall live on the workspace. The properties window shall support edit functions for any object selected.

2.7.5.2.5 Object properties shall be passed when an object is copied. Copying should be able to occur from the tree browser or workspace. All properties shall be passed on to the duplicated object and the name properties shall automatically get changed.

2.7.5.2.6 Graphic screens that are opened in configuration mode shall support tiling and cascading. Tiling shall have horizontal and vertical support and no overlapping when the graphic screens are viewed in the manor. The only limit on the number of graphic screens opened at one time is by the amount or Ram in the PC. Cascading is defined as a method to stagger pictures so they can be selected from their title bar.

2.7.5.2.7 Size will be based on logical units, not pixels and any logical unit may be used. Graphic screen design at one resolution shall be able to run at a different resolution. A full screen option as well as the ability to add sizing borders to any graphic screen shall be supported. Also graphic screens shall have an option to enable the screen to always be on top and a title bar enabled / disabled option.

2.7.5.2.8 The graphic screens shall have the ability to have third party ActiveX controls dropped in. The OIT software shall be capable of containing any control that is placed onto a graphic screen. If a third party control crashes or misbehaves the OIT software shall be able to shut down the control while the graphic screen, OIT software and PC remains running. Running third party controls out of the process is not a suitable requirement for the protection.

2.7.5.3 Color Support

2.7.5.3.1 The graphics package shall provide support for an unlimited choice of colors with 256 colors supported at any one time.

2.7.5.3.2 The OIT software shall come with a standard, rainbow color palette as well as several standard shades of color palettes. Each shade palette needs to have 256 shades.

2.7.5.3.3 Color changes shall be selectable from editing the individual foreground, background, or edge color property for each object.

2.7.5.3.4 Color changes shall be selected from a "Modeless" color box. The "modeless" color box shall float on the workspace and allow the user to change color on as many objects as they wish and choose which property of an object or objects they wish to change.

2.7.5.3.5 The OIT software shall allow for a global or universal color table selections. This table is based on exact match, or range compression or a value. The colors in the tables will appear on any graphic screen when the value for the data source of the object matches the table. Changes to color tables shall be independent of the graphic screens and not require the user to compile or pass the graphic screen through the graphic configuration program or mode for changes to take place.

2.7.6 Alarm and Message Handling

2.7.6.1 General

2.7.6.1.1 The OIT software shall be capable of detecting alarm conditions based on the states and values of the various sensed variables.

2.7.6.1.2 The alarm conditions shall be detected even if the variables causing alarms are not currently on the display.

2.7.6.1.3 Alarms will be used to report potentially harmful process conditions requiring a response. Messages are to report non-critical information that does not require a response.

2.7.6.1.4 Alarm limits can be entered by the user at configuration time or from the operator's display during run-time. Alarm limits shall be expressed in engineering units.

2.7.6.2 Alarm Types

Analog input or alarm variables shall have the following alarm types:

- High High
- High
- Low
- Low Low

- Time rate-of-change
- Bad input from I/O
- Alarm Disable
- Off Scan
- Change of State

2.7.6.3 Alarm Priorities and Filters

The OIT software shall support at least 3 alarm priorities for each alarm type: High, Medium and Low. A filtering mechanism shall be provided so that the operator can adjust the system alarm priority. The handling shall be as follows:

- Low- High, medium, and low alarm priorities
- Medium- High and medium alarm priorities
- High- High alarm priorities

2.7.6.4 Messages

2.7.6.4.1 Messaging enabling and disabling shall be controlled at the block level. The OIT software shall be able to send messages based on the following events.

- An operator initiated event occurs
- A process database event occurs
- A system-level event occurs

2.7.6.4.2 System messages are messages that will provide information about completed tasks and errors. System Messages will occur when:

- A database finishes loading
- The state of a network session changes
- An I/O/ driver detects an error
- Start-ups occur
- Database block errors occur
- Run-time or system errors occur

2.7.6.4.3 System errors will be viewed by a pop up message viewer. The viewer should allow users to show all entries or just new ones, maximize on next new entry, clear, and exit, and disable the viewer from popping up.

2.7.6.5 Alarm Areas

2.7.6.5.1 In order to logically divide a process into smaller units, the OIT software shall allow for unlimited, named individual alarm areas to be defined. These alarm areas shall be definable on an individual tag level. All alarm areas shall be accessible by each tag and the OIT software shall support multiple alarm areas per tag.

2.7.6.5.2 Alarm areas are used to determine which destinations receive each alarm. The method of alarm distribution over a network shall be session-based in order to guarantee alarm distribution and reception. Broadcasting of alarms on the network shall not be permitted.

2.7.6.5.3 Each alarm block shall be able to support an area where you can associate a graphic screen for the alarm.

2.7.6.6 Alarm Destinations

2.7.6.6.1 The OIT software shall provide a means for placing an alarm message in one or more of the following locations:

- Alarm summary display
- Alarm printer
- Alarm message file on disk
- Alarm history window (first-in, first-out scrolling window on the display)

2.7.6.6.2 Alarm messages shall be independently user-configurable as to what information is provided and its sequence within the message. The following shall be available choices:

- Time of the alarm
- Name of the tag causing the alarm
- Alarm condition code
- Engineering units value when the alarm occurred
- Descriptor text assigned to the tag
- Engineering units of the tag

2.7.6.6.3 The user shall be able to specify the length of the alarm queue for each destination.

2.7.6.7 Time Stamping

2.7.6.7.1 A time stamp shall be included with every alarm or message. This time stamp will indicate the time and date that the alarm or message was generated.

2.7.6.7.2 Time stamping shall be supported from the local computer time, OPC server time, or process hardware's clock.

2.7.6.8 Alarm Notification and Acknowledgment

2.7.6.8.1 When a new alarm condition is detected, an alarm message will be generated.

2.7.6.8.2 If the alarm condition code text for the block is on the current display, then the text will flash until the alarm is acknowledged. Alarm acknowledgment will be performed from the operator's keyboard or with the mouse and shall require no more than one keystroke or mouse click.

2.7.6.8.3 The OIT software shall be capable of "freezing" the highest alarm status value on the display until acknowledgment is made. Once acknowledgment is made, the OIT software will display the current alarm status text.

2.7.6.8.4 The software shall provide built-in capabilities to support the following:

2.7.6.8.4.1 Remote acknowledgment. This shall allow, for example, a button to be depressed by the operator, which closes a digital tag and acknowledges one or more alarm conditions, as configured by the user.

2.7.6.8.4.2 Alarm suspension. This shall allow the user to specify tags that cause alarms not to be generated for one or more alarm conditions.

2.7.6.8.4.3 Delay time. This shall allow the user to specify a period of time for which an alarm condition shall remain before an alarm is generated.

2.7.6.8.5 When an alarm is acknowledged from any node on the network, the acknowledgment shall be made directly at the node from which the alarm was generated, and a message indicating that it has been acknowledged shall then be distributed to all alarm destinations.

2.7.6.9 Alarm Summary Display

2.7.6.9.1 The OIT software shall offer an alarm summary display as a pre-defined, customizable, OCX, dynamic link within the graphics package. This alarm summary display shall show a list of the pending alarms in the OIT software. As new alarms are detected, entries are made to the display list. As the alarm conditions clear, the entries are removed from the list.

2.7.6.9.2 In addition to being able to configure the placement of the information (tag name, current value, descriptor, time of alarm, and alarm status), the user shall be able to specify the color codes to be used to indicate the various alarm conditions.

2.7.6.9.3 Alarms can be acknowledged from the alarm summary display either individually (by clicking on an alarm acknowledgment field) or for all alarms in the queue.

2.7.6.9.4 The alarm summary display shall provide sorting and filtering capabilities. The user shall be able to filter on node name, alarm area(s), alarm status and alarm priority. The user shall be able to sort on time, tag, alarm area, alarm priority and alarm status. The user shall be able to display field or fields about the alarm block in a column format and do complex filtering.

2.7.7 Archiving and Reporting

2.7.7.1 General

2.7.7.1.1 The OIT software shall provide a facility for automatically collecting, storing and recalling data. Recalled data will be made available to a trend display program, a report generation program and to user-written programs.

2.7.7.1.2 The OIT software shall support data archiving directly into an ODBC compliant database.

2.7.7.2 Data File Handling

2.7.7.2.1 Data will be stored in Windows-compatible files in compressed format. Compression will be performed through a user-supplied deadband. Entries containing time, name, value and status will be made in the file whenever the real-time value exceeds the previously stored value by the deadband limit. A deadband value of zero will cause an entry in the file each time the real-time value is examined.

2.7.7.2.2 Files shall be organized according to time and shall contain values for multiple, named variables. The file can be placed on the hard disk or a floppy disk, and can be placed on a file server if LAN server software in installed.

2.7.7.2.3 A mechanism for on-line maintenance and automatic purging of files shall also be provided.

2.7.7.2.4 The OIT software shall support third party applications for ODBC queries.

2.7.7.3 Archive Configuration

2.7.7.3.1 The data to be collected by the archiving program shall be identified through an interactive, menu-based configurator. The user shall enter the tag name, collection rate, and data compression deadband value. Collection Rates shall be adjustable from 1 second to 30 minutes.

2.7.7.3.2 The collection task can be run at any one (1) or more computers on the network. The task shall have the ability to access data from the memory-resident tag list in its own computer and/or any computer(s) on the network.

2.7.7.4 Displaying Archived Data

2.7.7.4.1 The operator shall be able to recall archived data from the disk to be displayed in graphic format along with Real-time data.

2.7.7.4.2 The display of archived data shall be user-configurable. It shall be possible to configure objects in graphic displays that, when selected, fetch pre-defined historical trend data from disk and display it to the operator. The OIT software shall allow for users to edit a pen's attributes during runtime.

2.7.7.4.3 The display shall support unlimited variables to be displayed on the same time/value axis simultaneously. For each entry in the display list, the operator will be able to assign a given tag name and marker to a particular line color selected from palettes of unlimited colors. The operator may also enter display engineering units ranges to cause scaling of the display. Support shall be provided for multiple, different y-axis engineering units to be displayed, as appropriate.

2.7.7.4.4 The display shall have two fields of view: The top portion of the screen shall be the graphic field and will display the values of the variables (y-axis) against time (x-axis). It shall also contain labels for the axes and graphs. The bottom portion of the screen shall be user-configurable to display information, such as node names, tag names, and descriptors, pertaining to the tags in the trend display.

2.7.7.4.5 A movable, vertical line will act as a time cursor on the display. This cursor can be moved by dragging it with the mouse. The date, time, and values of the trends corresponding to that time will be displayed in the bottom portion of the screen for all variables shown on the screen.

2.7.7.4.6 The grid of the trend object shall be scrollable.

2.7.7.4.7 The trend may be shifted forward or backward in time ("panning") by clicking on left/right buttons. New data will be fetched from the historical file as appropriate. Two sets of buttons shall be provided that cause shifting by different amounts of time. The amount of time shifting caused by these buttons shall be user-configurable.

2.7.7.4.8 The ability to display historical (pre collected) data with current (real time) data on the same chart shall be supported.

2.7.7.4.9 The user shall be able to "zoom" in on any section of the trend display by "cutting" that section with a mouse. The software will automatically re-scale both the y-axis and time axis and will fetch the appropriate data for the time period selected.

2.7.7.4.10 The trend object shall have a refresh rate selectable in .1 second increments from a minimum of 0.10 seconds to a maximum of 1800 seconds.

2.7.7.4.11 The trend graphic display shall be printable to a black and white or color printer via the standard Microsoft Windows 2000 or XP Print Manager. The data contained in the display shall also be capable of being sent to an ASCII file or .PRN file.

2.7.8 Security Management

2.7.8.1 General

2.7.8.1.1 The software shall provide a user-based security system. If enabled, the security system shall allow for the creation of users with certain rights and/or privileges. These rights shall include the ability to run any combination or all of the applications in the data acquisition system. The ability to allow or disallow users access to change values, such as setpoints and machine-setups, on an individual tag basis shall be supported.

2.7.8.1.2 Groups of users, such as Operators or Supervisors, can be created and granted rights. All users assigned to a group obtain the rights of the group, although they are still tracked by the OIT software by their individual ID. Individual members of a group may also be assigned additional rights.

2.7.8.1.3 The security system will support either centralized or distributed security file management.

2.7.8.1.4 The OIT software shall support a tie to Windows XP security.

2.7.8.1.5 When user-based security is enabled, an audit trail will be generated in the OIT software, which will tag every operator action with a user identification (ID).

2.7.8.1.6 OIT software that uses a level-based security methodology shall not be acceptable.

2.7.8.2 Security Areas

2.7.8.2.1 The OIT software shall support up to 254 separate security areas. Security areas shall be assignable on a per tag basis. Each tag can be assigned all of the available security areas, none of the available security areas, or up to three (3) individual security areas.

2.7.8.2.2 Only users with clearance for those security areas shall have the ability to change parameters.

2.7.8.3 Security Manager

The following functions shall be supported within the security manager application:

- Enable/Disable user-based security
- Define users, passwords and login names
- Define groups to which users may belong
- Define security path(s)
- Define user and/or group rights/privileges
- Define security area names
- Define system auto-start user

2.7.8.4 Securing the Windows XP GUI Environment

2.7.8.4.1 The ability to "lock" an operator or other user into the runtime graphics environment shall be provided.

2.7.8.4.2 Disabling any combination of the following shall be supported, as configured by the user:

- Starting other applications

- Switching to other applications that may be running
- Exiting from the OIT software
- Restarting the computer using <Ctrl><Alt><Delete>
- Opening unauthorized graphic screens
- Closing the current graphic screens
- Using the system menu
- Switching to the configuration environment
- Accessing the system tree

2.7.8.5 Logging In and Out

2.7.8.5.1 The OIT software shall allow for a login timeout setting for each user account. This variable setting will logout an operator when the time interval expires.

2.7.8.5.2 The OIT software shall support manual login and logout as well as automatic login. In addition security information shall be customizable through VBA scripting.

2.7.9 Services

2.7.9.1 Warranty and Customer Support

The OIT software shall provide an extended warranty for support for a minimum of 18 months starting at substantial completion of the project and include software upgrades on disk to the owner at no additional cost.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

Refer to SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

3.2 FIELD TESTING AND INSPECTION

Refer to SECTION 01800 - TREATMENT SYSTEM OPERATION AND MAINTENANCE and SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

3.3 TRAINING

Refer to Section 01850 - FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND START-UP TRAINING.

END OF SECTION

SECTION 15200

PIPING, VALVES, AND APPURTENANCES

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall provide all necessary labor, supervision, materials, equipment, tools, manuals, plans, permits and services required to design, furnish, install, test, operate and maintain process and yard piping, valves, and appurtenances for a complete and operational groundwater extraction and treatment system.

1.1.2 The influent and effluent lines (yard piping) shall be high density polyethylene (HDPE) pipe or equivalent. Water process piping lines shall be polyvinyl chloride (PVC) pipe or equivalent. Air process piping shall be flexible hose. Process bower piping line shall be stainless steel.

1.1.3 The Contractor shall heat trace, insulate and protect all pipes exposed to the weather from freezing and condensation.

1.2 REFERENCES

The publications listed below form part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the below standards, the revision in effect at the time of contract award shall apply.

<u>AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)</u>

B2.1	Standard for Welding Procedure and Performance Qualification
B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
B16.5	Pipe Flanges and Flanged Fittings
B16.9	Factory-Made Wrought Steel Buttwelding Fittings
B31.1	Power Piping
B36.19	Stainless Steel Pipe

<u>AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)</u>

ASTM A 48	Gray Iron Castings
ASTM A 126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

ASTM A 530	Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
ASTM A 744	Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service
ASTM A 778	Welded, Unannealed Austenitic Stainless Steel Tubular Products
ASTM C 536	Method for Continuity of Coatings in Glassed Steel Equipment by Electrical Testing
ASTM D 1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2104	Polyethylene (PE) Plastic Pipe, Schedule 40
ASTM D 2239	Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2241	Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2447	Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2609	Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
ASTM D 2657	Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D 2683	Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	Polyethylene (PE) Plastic Tubing
ASTM D 2774	Underground Installation of Theroplastic Pressure Piping
ASTM D 2837	Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
ASTM D 2855	Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3035	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

ASTM D 3222	Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials
ASTM D 3261	Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3350	Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3892	Packaging/Packing of Plastics
ASTM D 4101	Polypropylene Injection and Extrusion Materials
ASTM F 336	Design and Construction of Nonmetallic Enveloped Gaskets for Corrosive Service
ASTM F 402	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 656	Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM F 714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based On Outside Diameter
ASTM F 876	Crosslinked Polyethylene (PEX) Tubing
ASTM F 1055	Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
ASTM F 1056	Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings

AMERICAN SOCIETY OF SANITARY ENGINEERS (ASSE)

ASSE ANSI/ASSE 1001	Performance Requirement for Atmospheric Type Vacuum Breakers
ASSE ANSI/ASSE 1012	Performance Requirement for Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	Performance Requirement for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
ASSE 1015	Performance Requirement for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
ASSE 1020	Performance Requirement for Pressure Vacuum Breaker Assembly

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA M-11	Steel Water Pipe: A Guide for Design and Installation

AWWA C 111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C 500	AWWA Standard for Metal-Seated Gate Valves for Water Supply Service
AWWA C 504	Rubber-Seated Butterfly Valves
AWWA C 901	Polyethylene (PE) Pressure Pipe and Tubing, 1/2in. (13mm) Through 3 in. (76mm), for Water Service

NATIONAL SANITATION FOUNDATION (NSF)

NSF - 14	Plastic Piping System Components and Related Materials

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	Pipe Hangers and Supports - Selection and Application
MSS SP-89	Pipe Hangers and Supports - Fabrication and Installation Practices
MSS SP-80	Bronze Gate, Globe, Angle and Check Valve

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	Hazardous Chemical Data
NFPA 325	Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	Standard System for the Identification of the Hazards of Materials for Emergency Response

1.3 SUBMITTALS

The general submittals for piping and piping systems are listed below. It is not intended that all submittals listed below be provided for all piping materials and systems. Process piping, valves, and appurtenances submittals should be included with the individual performance specification submittals. Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Shop Drawings; Shop Drawings; EA

Piping layouts in full detail.

1.3.1.1 Location of pipe hangers and supports.

1.3.1.2 Location and type of backup block or device to prevent joint separation.

1.3.1.3 Large scale details of floor slab penetrations, wall penetrations and fabricated fittings.

1.3.1.4 Schedules of all pipe, fittings, special castings, couplings, expansion joints, and other appurtenances.

1.3.2 Product Data; Product Data; EA

Catalog cuts of joints, couplings, hangers, supports, harnesses, expansion joints, gaskets, fasteners, and other accessories.

1.3.2.1 Brochures and technical data on coatings and linings and proposed method for application and repair.

1.3.3 Statements of Satisfactory Installation and Thrust Restraint Methods; Test Reports; FIO

1.3.4 Equipment Samples as appropriate; Samples; FIO

1.3.5 Design Data and Assumptions; Design Data; EA

1.3.6 Certified Shop Tests; Certificates; FIO

Test results showing compliance with appropriate standard.

1.3.7 Performance Testing; Test Reports; FIO

Results of testing performed in accordance with Paragraph 3.13- Testing.

1.3.8 Certification; Certificates; FIO

Certificates for all welders performing work in accordance with ANSI B31.1.

1.3.9 Manufacturer's Certification; Certificates; FIO

Certification that materials meet or exceed minimum requirements as specified and other certificates as required.

1.3.10 Equipment/System Warranty; Certificates; FIO

The Contractor shall provide copies of equipment warranties for all equipment covered under this Section upon receipt of equipment. The equipment shall be warranted by the manufacturer for a period of one year.

1.3.11 All submittals shall be sealed, signed, and dated by a professional engineer registered in the State of New York.

1.3.12 All deviations from this Section shall be delineated in the submittals.

1.4 QUALITY CONTROL

1.4.1 All materials shall be new and unused.

1.4.2 The Contractor shall install piping, valve, and appurtenances to meet requirements of local codes.

1.4.3 The Contractor shall provide manufacturer's certification that materials meet or exceed minimum requirements as specified herein.

1.4.4 The Contractor shall coordinate dimensions and drilling of flanges for valves, pumps, and other equipment to be installed in piping systems. Bolt holes in flanges shall straddle vertical centerline.

1.4.5 The Contractor shall reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner, and acid solder.

1.4.6 Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of underwriter laboratories (UL) or factory mutual (FM).

1.4.7 All plastic pipe and fittings of each type shall be furnished by a single manufacturer who is experienced in the manufacture of the items to be furnished. The pipe and fittings shall be designed, constructed, and installed in accordance with the best practices and methods and shall be suitable for the intended service.

1.5 DESCRIPTION OF SYSTEM

The system shall include all piping, valves, and appurtenances for a complete operational system in accordance with SECTION 02525 - EXTRACTION WELL INSTALLATION AND TESTING, SECTION 13300 - GROUNDWATER TREATMENT SYSTEM, and SECTION 11319 - SUBMERSIBLE WELL PUMPS.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 During loading, transportation, and unloading, take care to prevent damage to equipment. Particular care shall be taken not to injure the pipe coating or lining.

1.6.2 The Contractor shall carefully load and unload each piece of equipment under control at all times. Skids or blocks shall be placed under equipment as necessary.

1.6.3 Piping and fittings shall be stored and handled in accordance with the manufacturer's recommendations. Storage facility shall be classified and marked in accordance with NFPA 704 with classifications as indicated in NFPA 49 and NFPA 325.

1.6.4 The Contractor shall protect the piping and fittings from entrance of foreign materials. All male threaded ends shall be protected with end caps.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Polyvinyl Chloride (PVC)

2.1.1.1 Installed PVC pipe that is exposed to sunlight shall be painted for UV protection.

2.1.1.2 Pipe shall be manufactured from PVC compounds meeting ASTM D 1784, Class 12454-B requirements, and shall conform to ASTM D 1785. Pipe shall be Schedule 80 unless approved otherwise by the Engineer.

2.1.1.3 Materials from which pipe are manufactured shall have been tested and listed for conveying potable water by the NSF.

2.1.1.4 The piping system shall be joined by socket-weld connections except where connecting to unions, valves, and equipment with threaded connections that may require future disassembly.

2.1.1.5 Connections at those points shall be threaded and back-welded. Tubing connections shall use compression fittings.

2.1.1.6 Fitting components that utilize socket-type solvent welded connections shall have socket diameters, lengths, and wall thickness as required by ASTM D 2466 or D 2467. Components utilizing taper pipe thread connections shall have thread lengths, diameters, and configurations in conformance with ASTM D 2464.

2.1.1.7 Fittings shall be industrial, heavy duty, hub style.

2.1.1.8 Pipe fittings shall be manufactured from a PVC compound that meets the requirements of Cell Classification 12454-B PVC as outlined in ASTM D 1784. PVC shall be gray in color. Fittings shall be specially formulated with sufficient UV screeners to provide for long-term outdoor exposure with no deleterious effects.

2.1.1.9 Push-on Joints. Push-on type joints shall be sealed with ethylene propylene rubber (EPR) gaskets in accordance with ASTM F 477.

2.1.1.10 Flanges shall be one piece solid design or two-part van stone type, which utilize the tapered, serrated face and full face gasket technique for joining and are compatible with ANSI B 16.5 Class 150 metal flanges.

2.1.1.11 Unions shall be O-ring seal type having interchangeable components with true union valves for maximum system versatility.

2.1.1.12 Unions intended for joining dissimilar materials shall be the transition type, which utilize components of the two dissimilar materials, joined with an O-ring to absorb the thermal expansion coefficient differential.

2.1.1.13 Fittings and pipe shall be clearly marked with the manufacturer's name and trademark, material, ASTM number or alternate symbol indicating compliance with applicable standards, NSF seal of approval indicating compliance with applicable ASTM standards, NSF seal or approval indicating compliance with NSF Standard 14 for the conveyance of potable water, and further indicating compliance with the applicable ASTM standard and the country of manufacture.

2.1.1.14 Socket fittings shall be pressure rated the same as the corresponding size pipe prescribed by ASTM D 1785. Threaded fittings shall be in accordance with applicable ASTM standards.

2.1.1.15 Valves, unions, and flanges shall be pressure rated at 150 psi for water service at 73 degrees F (°F), nonshock and have a minimum burst requirement of 3.3 times the rated pressure.

2.1.1.16 Solvent cement shall be as specified in ASTM D 2564.

2.1.2 High Density Polyethylene (HDPE)

2.1.2.1 Pipe shall be manufactured from HDPE base resin conforming to Grade P34 (Plastic Pipe Institute designation PE3406 or better) in accordance with the requirements of ASTM D 2447. Pipe shall be Schedule 80 unless approved otherwise by the Engineer.

2.1.2.2 The pipe shall have a minimum hydrostatic design stress of 630 psi at 73°F and be suitable for field cutting and heat fusion joining. Pipe shall be SDR 21 unless otherwise shown.

2.1.2.3 Fittings shall be the butt type for heat fusion joints conforming to ASTM D 3261, except that fittings shall be fully pressure rated.

2.1.2.4 Heat fused joints shall be pressure rated the same as the corresponding pipe.

2.1.2.5 Flanges shall be one-piece solid design.

2.1.2.6 Fittings shall be manufactured from the same HDPE base resin, conforming to Grade P34, Class C (PPI PE3406 or better), as is used to produce the pipe to which the fittings are to be joined.

2.1.2.7 Both pipe and fittings shall be manufactured by the same manufacturer to assure compatibility of the piping system components.

2.1.3 Polyethylene (PE)

2.1.3.1 Pipe, tubing, and heat-fusion fittings shall conform to AWWA C 901 and ASTM D 2737.

2.1.3.2 Joints for pipe fittings and couplings shall be strong tight joints as specified for PE in Paragraph 3.3. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendation and as approved by the Engineer.

2.1.4 Stainless Steel

2.1.4.1 Pipe and fittings shall be Schedule 5S. All piping materials shall be seamless or welded, austenitic stainless steel pipe Grade Type 304L conforming to ASTM A778 and ANSI B36.19 and ASTM A744 for fittings. Finish shall be No. 1 or better. For fittings, the butt weld shall be full penetrations. Riser pipe in the extraction wells used to convey water up the well from the pump shall be threaded pipe.

2.1.4.2 Pipe shall be die-formed or rolled true to dimension and round. Tolerances for length, inside and outside diameter and straightness shall conform to ASTM A 530. Longitudinal seams on pipe and fittings shall be welded by either the tungsten gas or the metallic-gas method. All pieces shall be marked with gauge and type of stainless steel and with the initials of the inspector marked on the inside of each piece, at each end.

2.1.4.3 Flanges for pipe 4 inches and smaller shall be of the type of stainless steel as the pipelines and shall be welded directly to the pipe end, and shall be drilled to the 125 lb ANSI B16.1 standard. Flanges for pipe larger than 4 inches shall have stub ends or rolled angle rings of the type of stainless steel as the pipeline welded to the pipe end. With suitable gaskets between the mating surfaces and joined through the use of 125 lb rated back-up flanges, drilled to ANSI B16.1.

2.1.4.4 Shop welding fabrications shall be done according to the procedures and by welders certified per ANSI requirements.

2.1.5 Flexible Hose

Flexible hose for the off-gas systems shall be rubber or two ply polyester, neoprene coated industrial hose, manufactured by Dura-Vent, or equivalent. The hose shall be attached to the off-gas units using quick-connect fittings.

2.1.6 Harnessing

Proper harnessing, complying with the requirements of AWWA M-11, shall be furnished and specifically installed as required on all pressure pipelines.

2.1.7 Electrically Insulating Joints

Insulating/dielectric joints shall be installed between dissimilar types of metallic pipes, fittings, and valve and at all metallic connections to equipment, and between aboveground and below-ground piping. Insulating flange joints shall consist of a sandwich-type flange insulating gasket of dielectric type, insulating washers, and insulating sleeves for flange bolts. Insulating gaskets shall be full-faced with outside diameter equal to the flange outside diameter. Bolt insulating sleeves shall be full-length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements. Dielectric unions, on screwed joints, shall be of standard insulating type to prevent metal-to-metal contact.

2.2 VALVES AND APPURTENANCES

2.2.1 General

2.2.1.1 The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be on the body of each valve. Connections shall be suitable for the type of pipe they are installed on. Where shown in wells or buried, connections shall be suitable for earth burial and full submersion under water.

2.2.1.2 All valves shall be suitable for installation and operation when carrying, and fully submersed in chlorinated solvent products.

2.2.1.3 Manual valves on lines 3 inches and smaller shall be full port ball valves. Manual valves on lines greater than 3 inches shall be butterfly valves except for buried valves which shall be gate valves.

2.2.1.4 The Contractor shall be responsible for selecting the proper valve materials. Plastic valve requirements are described in Paragraph 2.4.

2.2.1.5 Buried valves shall be especially constructed for buried service.

2.2.2 Check Valves

2.2.2.1 Check valves shall be suitable for the minimum pressure of not less than 150 psi. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharger pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure.

2.2.2.2 Valves 2 inches and smaller shall be all bronze designed for threaded fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

2.2.2.3 Valves larger than 2 inches shall be iron body, bronze mounted, and shall be the non-slam type. Flanges shall be the 125-pound type conforming to ANSI B16.1.

2.2.3 Gate Valves

2.2.3.1 Gate valves shall be suitable for the minimum pressure of not less than 150 psi. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

2.2.3.2 Valves shall be suitable for installation and operation when directly buried underground in soil containing chlorinated solvent products.

2.2.3.3 Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

2.2.3.4 Valves 3 inches or larger shall be iron body, bronze mounted, and shall conform to AWWA C500.

2.2.3.5 Buried valves shall have nonrising stems, mechanical joint ends and 2-in square operating nuts. Valves shall be furnished with O-ring seals.

2.2.4 Ball Valves

2.2.4.1 The design of the valve shall be such that it shall provide suitable seating in both directions. In order to determine the position of the ball within the valve (closed) there shall be an easily-visible, permanent indicator located conspicuously on the valve.

2.2.4.2 The valves shall be constructed so that the seals, seats, and balls are accessible for replacement without dismantling the piping.

2.2.4.3 Full-port ball valves shall be furnished.

2.2.5 Combination Air Vacuum/ Air Pressure Release Valve

2.2.5.1 Combination air valves shall be of the single housing style that combines the operating features of both an air vacuum and air pressure release valve.

2.2.5.2 The air pressure portion of the valve shall automatically exhaust large quantities of air during the filling of the tank and the air vacuum portion of the valve shall automatically allow air to re-enter the tank when the internal pressure of the tank approaches a negative value because of draining/ discharge of the tank.

2.2.5.3 The materials of construction shall be: body, cover, and baffle of cast iron; float and all other trim shall be of stainless steel with the exception of the Buna "N" seat and adjustable viton orifice button. The pressure/vacuum relief setting shall be selected to protect the tanks.

2.2.6 Backflow Preventer Valves

2.2.6.1 Backflow preventers shall work on the reduce pressure principal. They shall consist of two spring-loaded check valves, automatic differential pressure relief valve, drain valves, and shut-off valves.

2.2.6.2 The body material shall be bronze or cast iron for a working pressure of not less than 150 psi, with bronze or stainless steel trim.

2.2.6.3 Drain line with air gaps shall be provided.

2.2.7 Butterfly Valves

Butterfly valves shall be constructed of close grain cast iron per ASTM A 126, Class B with integrally cast hubs for shaft bearing housings of the through boss-type. Valve seats shall be full resilient seats retained in the body or on the disc edge in accordance with AWWA C504. Valve disc shall be constructed of cast iron, ASTM A48, Class 40 or ductile iron, ASTM A536, Grade 65-45-12. Valve shaft seals shall be EPT or TFE encapsulated O-ring and stem shall be Type 316 stainless steel stem. The valve shall be constructed to prevent contact of the fluid carried and the stem. Each valve shall be equipped with a locking lever type actuator, or, for valves more than 7-feet above the floor, a chain lever actuator.

2.3 PLASTIC VALVES

2.3.1 General

2.3.1.1 All valves shall be certified as completely compatible with the intended and specified service. Compatibility shall apply to the material of the valve and internal components, including all seals, gaskets, O-rings and washers. Solvents and primers used in valve joint make-up shall be specifically in conformance with the written instructions of the valve supplier.

2.3.1.2 Except as otherwise specified valve ends shall be socket-type designed for solvent welding. The valve manufacturer shall provide specific recommendations for solvent and primer.

2.3.1.3 Valve material shall be the same as the piping service except as specified.

2.3.1.3.1 PVC shall be Type 1, Grade 1, per ASTM D1784.

2.3.1.3.2 PP shall conform to the material requirements of ASTM D4101 for copolymer polypropylene.

2.3.1.4 Except as otherwise specified O-rings, valve seats and stem seals shall be teflon, or teflon encapsulated elastomer; gaskets shall be made from PTFE-bonded sheet material; valve external hardware shall be Type 316 stainless steel; and no factory or field coatings shall be applied to the valves.

2.3.1.5 All valves, except butterfly valves shall have a non-shock service pressure rating or not less than 120 psig at 70 degrees F.

2.3.1.6 All valves shall be given hydrostatic and pressure and leakage tests at the factory.

2.3.2 Ball Valves

Ball valves shall be double-union type with full port opening.

2.3.3 Butterfly Valves

Butterfly valves shall have PVC body and PP disc, with teflon seat and teflon O-ring shaft seals fully isolating a Type 316 stainless steel stem. The valve shall be of the lug or wafer type, suitable for dead end service. Each valve shall be furnished with a lever actuator with a minimum of ten incremental position stops. Level actuators for exterior service shall be certified UV resistant.

2.3.4 Check Valves

2.3.4.1 Ball check valves shall be double-union style with socket ends, solid and completely spherical ball and capable of either horizontal or vertical mounting.

2.3.4.2 Swing check valves shall be flanged, full ported, with top entry access for disc inspection and removal. Valve shall be furnished with outside lever and weight, with weight position along lever arm adjustable.

2.3.5 Control Valves

Control valve shall be spring-loaded diaphragm design, fully-adjustable pressure setting, set to assure continuous positive pressure at the pump discharge. Valve shall be furnished with teflon diaphragms and elastometer-coated springs.

2.3.6 Pressure Relief Valve

Pressure relief valve shall be angle-pattern design, with adjustable relief pressure and locking nut. The valve spring shall be elastomer-coated and isolated from the process flow. Valve shall be spring-loaded with pressure adjustable over range up to 100 psig.

2.4 PIPE AND VALVE INSULATION AND HEAT TAPE

2.5.1 Insulation shall be non-water absorbing, less than 1 percent by volume per 28 days, closed cell rigid foam, form-fitted for piping with a minimum U of 0.075 suitable. It shall be covered with weather-tight aluminum sheathing for its entire length (even below grade).

2.5.2 Insulation shall be placed around pipe outside the vault where the pipe is less than 54 inches below ground surface.

2.5.3 Heat tape shall be UL- or FM-listed for explosion-proof installations. It shall be suitable for use with the type and size of pipe noted, complete with adjustable thermostat. It shall be suitable for maintaining the temperature of the pipe at approximately 40°F, when outside temperature is at -20°F.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 All dirt, scale, weld splatter, water, and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.

3.1.2 All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.

3.1.3 All PVC pipe and fittings exposed to direct sunlight shall be protected from UV radiation.

3.1.4 All pipes shall be sized for a minimum velocity of 2 feet per second. Gravity lines shall be sized to flow at a maximum of half full at the design flow rate.

3.2 PIPING INSTALLATION REQUIREMENTS

3.2.1 Piping shall be installed in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb.

3.2.2 All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes and Pipe Fabrication Institute Standards.

3.2.3 The full length of pipe shall be used except where cut lengths are necessary. Do not spring or deform piping to make up joints.

3.2.4 Pipe shall be cut square, not upset, undersize or out of round. Ends shall be carefully reamed and cleaned before being installed.

3.2.5 Liquid and air piping at each fixture or unit of equipment shall be provided with a shut-off valve and union, whether disconnection of each fixture or unit of equipment, can be performed without disturbing the remainder of the system. Vapor piping shall be provided with sectionalizing valve and valved air inlet connections as required for isolation of portions of the system for periodic testing.

3.2.6 All air piping shall be graded to points of drainage collection where driplegs and drain valves shall be provided. Branch connections in horizontal runs of air piping shall be made from the top of the pipe.

3.2.7 Connections to different type of pipe shall be taped prior to applying primer or paint to avoid staining connecting pipe. Where sleeve type coupling are used, both shall be uniformly torqued in accordance with pipe manufacturer's recommendation.

3.2.8 All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the hydrostatic test.

3.2.9 End caps on pre-cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

3.2.10 The installation of plastic pipe shall be strictly in accordance with the manufacturer's technical data and printed instructions.

3.2.11 All plastic pipe to metal pipe connections shall be made using flanged connections. Metal piping shall not be threaded into plastic fittings, valves, couplings nor shall plastic piping be threaded into metal valves, fitting or couplings. Only socket to thread adaptors shall be used for threaded plastic pipe connections to other threaded devices.

3.3 PVC

3.3.1 Pipe shall be Schedule 80 unless otherwise approved by the Engineer.

3.3.2 Socket connections shall be joined by the solvent cement method in accordance with the manufacturer's printed recommendations and ASTM D 2855 by persons qualified to perform such joining.

3.3.3 Solvent cement: Industrial heavy bodies solvent cement having a viscosity rating of 1,600 cps (minimum) and of same relative color as the materials to be joined shall be used for Schedule 80 connections. For PVC sizes larger than 6-inch, an extra heavy duty solvent cement having a viscosity rating of 15,000 cps (minimum) shall be used. The solvent cement used shall be of type that utilizes tetrahydrofuran (THF) as the primary solvent and is in conformance with the requirements of ASTM D2564 and NSF Standard 14.

3.3.4 Primer: The primer shall be an organic solvent such as THF and be capable of dissolving at least 10 percent by weight of PVC resin within 60 minutes at 73°F. Primer shall be tinted purple for traceability. Primer shall be in conformance with the requirements of ASTM F656 and NSF Standard 14.

3.3.5 Threaded connections shall be joined in accordance with the manufacturer's printed recommendations. Pure TFE tape or pure TFE paste shall be used as a thread lubricant. No other compounds shall be used.

3.3.6 Expansion joints shall be installed with at least one expansion joint or loop near the center of each straight run of pipe which is 50 feet or longer with the maximum spacing between expansion joints or loops being 150 feet.

3.4 HDPE

3.4.1 Joints for HDPE pipe shall be butt heat fusion. Butt heat fusion joints shall be made in accordance with the requirements of ASTM D 2657.

3.4.2 Due to its large coefficient of thermal expansion, HDPE pipe shall be installed at its maximum operating temperature to prevent sagging between the hangers or supports. Supports at each end of the straight HDPE pipe runs shall be of sufficient strength to develop anchoring forces adequate to oppose the tensile forces developed in the pipe due to thermal contraction. The exception to this requirement shall be for flanged HDPE connections, because, if the flanged connection is made up at the maximum operating temperature, the thermal contraction of the flange thickness will reduce the required tensile force in the flange bolts. Flanged HDPE connections shall, therefore be made up at the lowest expected operating temperature and then the entire piping system shall be brought up to the maximum operating temperature for final installation. (Note: Packing the flanges in ice may be necessary to achieve the proper installation temperature).

3.5 STAINLESS STEEL

3.5.1 Mechanical joints shall be in accordance with AWWA C111 and the instructions of the manufacturer.

3.5.2 Flanged joints shall be made with gasket, bolts and nut bolts stud with a nut on each end, or studs with nuts where the pipe is tapped. The number and size of bolts shall conform to the same standard requirements as the flange.

3.5.3 Welding in the field shall be done only if approved by the Engineer. Field welds shall be made by welders certified under ASME requirements and be equal in all respects to shop welds. After field welding has been done, all joints shall be thoroughly cleaned and buffed using deburring and finishing wheels.

3.6 UNIONS

3.6.1 The Contractor shall use unions to allow dismantling of pipe, valves, and equipment.

3.6.2 Unions screwed or flanged shall be provided where indicated and in the following locations even if not indicated:

- In long runs of piping to permit convenient disassembly for alterations or repairs.
- In by-passes around equipment.
- In connections to tanks, pumps, and other equipment between the shut-off valve and the equipment.
- In connections on both sides of traps, controls, and automatic control valves.

3.7 VENTS AND DRAINS

The Contractor shall provide vents and drains in the following places:

3.7.1 Water Lines - Vents at high points and drains at low points.

3.7.2 Air Lines - Drains at low points.

3.8 WELDING

3.8.1 Welding shall be in accordance with ANSI B2.1 and B31.1.

3.8.2 The Contractor shall install welding fittings on all welded lines. The Contractor shall make changes in direction and intersection of lines with welding fittings. The Contractor shall not miter pipes to form elbows or notching of straight runs to form tees, or any similar construction. The Contractor shall not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

3.9 FLANGED JOINTS

The Contractor shall make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as flanges. Before flanges pieces are assembled, rust resistant coating shall be removed from machined surfaces. The Contractor shall clean gaskets and smooth all burrs and other defects. The Contractor shall make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.10 SLEEVE COUPLINGS

The Contractor shall install tie-rods, pipe clamps, or bridles when sleeve type couplings or fittings are used in piping system where indicated, and at changes in direction or other places as necessary, to prevent joints from pulling apart under pressure. Use bridles and tierods at least ¾ inch in diameter, except where tierods replace flange bolts of smaller size, in which case fit with nut on each side of pair of flanges. Joint harnessing shall conform, as a minimum, to the requirements for the bolts and tie bolt lugs as set forth in AWWA Manual M11.

3.11 WALL AND FLOOR SLEEVE SEALS

The Contractor shall use expandable rubber segmented sealing device with corrosion-resistant fasteners to make watertight the annular space between pipe and sleeve, as specified in SECTION 03410 - PRECAST CONCRETE STRUCTURES. The Contractor shall determine the required inside diameter of each individual wall opening or sleeve to fit the pipe and seal to assure a watertight joint as recommended by the manufacturer, before ordering, fabricating, or installing. The pipe shall be installed concentrically through wall sleeve. The Contractor shall install and tighten seal per manufacturer's instructions.

3.12 PIPE HANGERS AND SUPPORTS

3.12.1 All hangers, supports and appurtenances shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum safety factor for all supporting equipment, with the exception of springs, shall be five times the ultimate strength of the material, assuming 10-feet of waterfilled pipe being supported.

3.12.2 The piping hangers and supports shall be designed by a registered Professional Engineer in the State of New York, who shall have at least 5 years experience in the analysis and design of similar systems.

3.12.3 All pipes and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment.

3.12.4 Hangers and supports shall be spaced in accordance with ANSI B31.1 except that the maximum unsupported span shall not exceed 10 feet for metal piping and 5 feet for plastic piping unless otherwise specified.

3.13 YARD PIPING

3.13.1 Trenching shall be performed in accordance with SECTION 02300 - EARTHWORK.

3.13.2 No single piece of pipe shall be laid unless it is generally straight. Deflection of pipe shall not exceed that recommended by the manufacturer. If a pipe fails to meet this requirement, it shall be rejected and removed from the site, and replaced at no additional cost to the Government.

3.13.3 Clean outs shall be installed along the influent and effluent line every 300 feet and at bends, at a minimum, as shown on the Contract Drawings. The clean outs shall connect to the pipelines as shown on the Contract Drawing.

3.14 TESTING

3.14.1 The Contractor shall test all pipelines for water/gas tightness as specified herein. The Contractor shall furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gauges and all other equipment required. Testing shall be performed as specified below. All testing shall be performed in the presence of the Engineer.

3.14.2 The Contractor shall repair faulty joints or remove defective pipe and fittings and replace as approved by the Engineer. After repairs are made, the Contractor shall retest the affected areas of the system.

3.14.3 All pipelines shall remain undisturbed for the minimum curing or cooling time (if applicable) specified for each type of pipe material but no less than 8 hours to develop full curing and complete strength at all joints. All pipe systems shall be flushed clean and then subjected to a hydrostatic pressure test for 12 hours at a test pressure and temperature specified below. Testing procedures shall be as specified below. Should the temperature not be attainable under hydrostatic conditions, then the test may be performed under hydro-dynamic conditions, provided that accurate measurements for loss of the test fluid can be made, or the pressure shall be proportionally increased to simulate the stresses of the higher temperature in relation to the lowest system temperature that is expected during the duration of the test. The proportionally higher test pressures shall be determined in accordance with the accepted temperature versus strength properties as published by the pipe manufacturer, PPI or other pipe material standards organization. Allowance for expansion of polyethylene pipe during the test shall be made in accordance with PPI Technical Report TR31.

3.14.4 Hydrostatic test shall be conducted at 1½ times the design pressure and at ambient temperatures.

3.14.5 The test shall be performed by slowly filling the piping system, expelling entrapped air from all high points. The fill rate shall be controlled so that the fluid velocity within the pipe system is less than 2 feet per second. Upon completion of the filling process, the system shall be brought up to the specified test temperature as applicable, holding the system pressure to less than 10 percent of the test pressure. Once the system has been stabilized at the specified test temperature, the pipe should be slowly brought up to the test pressure in such a manner so as to not create shock, surge or water hammer in the pipe system. The test duration time limit shall not begin until the full pressure specified above has been reached and the system has been stabilized to within 5 percent of the test temperature. The system pressure and temperature shall be maintained to within ½ percent but no more than 5 percent of the specified value for the temperature and within 5 psi of the specified value for the pressure. These tolerances shall be held for the entire duration of the test. Upon completion of the test, the pressure shall be slowly removed by opening a valve or other pressure-relieving device at a location remote to the location of the pressure/temperature monitoring equipment.

3.14.6 The pressure test shall be monitored by a recording type pressure gauge for tests not requiring temperature control or a dual pen pressure/temperature recording gauge when temperature control is required. The entire test process shall be recorded, including the initial temperature stabilization and pressurization of the piping system. The record shall be continuous through the system test and shall show the final de-pressurization of the pipe system.

3.14.7 All visible leaks detected during the pressure test shall be repaired and the pressure/temperature test rerun. A successful test shall be a test in which no visible leaks are detected and the pipe system pressure can be maintained within ½ percent but no more than 5 psi of the specified value.

3.14.8 Prior to testing, the pipelines shall be supported in an approved manner to prevent movement during the tests.

END OF SECTION

SECTION 16000

ELECTRICAL - GENERAL PROVISIONS

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, materials, equipment, and incidentals required to install, complete, and make operational, electrical and process instrumentation systems as specified herein.

1.1.2 The work shall include furnishing, installing, and testing the equipment and materials specified in other Sections of the DIVISION 16 Specifications and as shown on the approved drawings.

1.1.3 Electric Service in the area is provided by Long Island Power Authority. The installation of service from the road to the treatment facility may be installed by the Contractor in accordance with SECTION 16375 – ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND or the electric company. The Contractor shall be responsible for the installation cost, regardless of who installs the service.

1.1.4 The work shall include furnishing and installing the following:

1.1.4.1 Conduit, wire and field connections for all motors, motor controllers, control devices, control panels, and electrical equipment furnished under other Specification Sections.

1.1.4.2 Conduit, wiring, and terminations for all field-mounted instruments furnished under other Specification Sections, including process instrumentation primary elements, transmitters, local indicators, and control panels.

1.1.4.3 Conduit, wiring and terminations for variable frequency drives, harmonic filters, transformers and power factor correction capacitors furnished and mounted under other Specification Sections.

1.1.4.4 Power wiring for all heating and ventilating equipment furnished under other Specification Sections, including power wiring for 120V unit heater motors and thermostats. Provide a 3/4-inch conduit, 2 #12 and 1 #12 GRD between each heater and its respective control thermostat.

1.1.4.5 Lightning and surge protection equipment wiring at process instrumentation transmitters.

1.1.4.6 Vendor furnished cables specified under other Specification Sections.

1.1.4.7 Precast handholes, pullboxes and light pole bases.

1.1.4.8 Pullbox, and handhole frames and covers.

1.1.4.9 Telephone service from the Telephone Company.

1.1.4.10 Electrical service from the Power Company.

1.1.4.11 Control systems including installation of auxiliary motor starter contacts, relays, switches, etc., as required to provide the control functions or inputs as shown on the approved drawings.

1.1.4.12 Panelboards, and motor controllers including installation of circuit breakers, etc., as required to provide the power supplies to new equipment.

1.1.4.13 Seismic Restraints for electrical equipment and systems requiring restraints.

1.1.4.14 Vendor furnished electric water heater capable of sufficiently providing hot water.

1.1.5 It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work that may be reasonably implied as being incidental to the work of this Section shall be furnished.

1.1.6 The Contractor shall field verify all existing underground electrical and mechanical piping.

1.1.7 The Contractor shall prepare and furnish electrical and instrumentation conduit layout shop drawings for yard electrical, within and under all roads to the Engineer for approval prior to commencing work. Layouts shall include but not be limited to equipment, pull boxes, manholes, conduit routing, dimensioning, methods and locations of supports, reinforcing, encasement, materials, conduit sizing, equipment access, potential conflicts, and all other pertinent technical specifications for all electrical and instrumentation conduits and equipment to be furnished. All layouts shall be drawn to scale.

1.1.8 The work shall include complete testing of all equipment and wiring at the completion of work and making any minor correction changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; substandard work will be rejected.

1.1.9 A single manufacturer shall provide transformers, disconnect switches, panelboards, etc.

1.1.10 The Contractor shall provide their own temporary power for miscellaneous power (drills, pumps, etc.). Any temporary equipment added shall be removed at job completion.

1.1.11 The Contractor shall install, wire, test and calibrate transmitters, process instruments, operator's stations, etc. furnished under other Specification Sections.

1.1.12 Concrete electrical duct encasement, including but not limited to excavation, concrete, conduit, reinforcement, backfilling, grading, and seeding is included in DIVISION 16. All work shall be done in accordance with DIVISIONS 2 and 3 of these specifications.

1.1.13 Excavation, bedding material, forms, concrete, and backfill for underground raceways, forms and concrete for electrical equipment furnished herein shall be done in accordance with DIVISIONS 2 and 3 of these specifications.

1.2 REFERENCES

1.2.1 The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply. Electric equipment, materials, and installation shall comply with the latest edition of National Electrical Code (NEC).

- NATIONAL ELECTRICAL SAFETY CODE (NESC)
- OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)
- NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
- NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
- AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
- INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
- INSTRUMENT SOCIETY OF AMERICA (ISA)
- UNDERWRITERS LABORATORIES (UL)
- FACTORY MUTUAL (FM)
- INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
- INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

1.2.2 All electrical equipment and materials shall be listed by Underwriter's Laboratories, Inc., and shall bear the appropriate UL listing mark or classification marking. Equipment, materials, etc. utilized not bearing a UL certification shall be field or factory UL certified prior to equipment acceptance and use.

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Shop drawings; Shop Drawings; EA

The Contractor shall check shop drawings for accuracy and contract requirements prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to the specifications and the approved drawings. This statement shall also list all exceptions to the specifications and the approved drawings. Shop drawings not checked and noted shall be returned. Shop drawings shall be submitted for the following equipment:

1.3.1.1 Raceways, Boxes, Fittings, and Hangers

1.3.1.2 Wires and Cables

1.3.1.3 Miscellaneous Equipment (as specified in SECTION 16191 - MISCELLANEOUS ELECTRICAL EQUIPMENT.)

1.3.1.4 Panelboards

1.3.1.5 Lighting Fixtures and Lamps

1.3.1.6 Switches, Receptacles, and Covers

1.3.1.7 Precast Manholes and Handholes, Frames and Covers

1.3.1.8 Grounding Hardware and Connections

1.3.1.9 Telephone System

1.3.1.10 Heat Tracing

1.3.2 Manufacturer's Product Information; Product Data; EA

The manufacturers name and product designation or catalog numbers shall be submitted for the following material utilized:

1.3.2.1 Testing Equipment

1.3.2.2 Ground System Resistance Test Equipment

1.3.3 Electrical Installation Drawings; Shop Drawings; EA

The Contractor shall submit electrical installation working drawings containing the following:

1.3.3.1 Concealed and buried conduit layouts, shown on floor plans drawn at not less than ¼-inch = 1 foot-0 inch scale. The layouts shall include locations of process equipment, motor control centers, transformers, panelboards, control panels and equipment, motors, switches, motor starters, large junction or pull boxes, instruments, and any other electrical devices connected to concealed or buried conduits.

1.3.3.2 Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.

1.3.4 Test Reports; Test Reports; FIO

Submit test reports as required by Paragraph 1.7 – Tests and Settings.

1.3.5 The Contractor shall submit operations and maintenance data under SECTION 01850 - FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND STARTUP TRAINING. The O&M manual shall include catalog data sheets, approved drawings, equipment lists, descriptions, parts lists, etc., to instruct operating and maintenance personnel unfamiliar with such equipment.

1.3.6 The Contractor shall check shop drawings for accuracy and contract requirements prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to the Specifications and the approved drawings. This statement shall also list all exceptions to the Specifications and the approved drawings. Shop drawings not so checked and noted shall be returned.

1.3.7 The Engineer's check shall be for conformance with the design concept of the project and compliance with the Specifications and the approved drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by the Specifications and the approved drawings.

1.3.8 All dimensions shall be field verified at the job site and coordinated with the work of all other trades.

1.4 ENCLOSURE TYPES

Unless otherwise specified herein or shown on the Contractor's approved drawings, electrical enclosures shall have the following ratings:

1.4.1 NEMA 1 for dry, non-process indoor locations.

1.4.2 NEMA 12 for "DUST" locations.

1.4.3 NEMA 4 for outdoor locations, rooms below grade (including basements and buried vaults), "DAMP," and "WET" locations.

1.4.4 NEMA 4X for "CORROSIVE" locations.

1.4. 5 NEMA 7 (and listed for use in the area classifications shown) for "Class I Division 1 Group D," "Class I Division 2 Group D," and "Class II Division 1" hazardous locations shown on the Contractor's approved drawings.

1.5 HAZARDOUS AREAS

1.5.1 Equipment, materials, and installation in areas designated as hazardous on the Contractor's approved drawings shall comply with NEC Articles 500, 501, 502, 503 and 504.

1.5.2 Equipment and materials installed in hazardous areas shall be UL listed for the appropriate hazardous area classification.

1.6 CODES, INSPECTION, AND FEES

1.6.1 Equipment, materials, and installation shall comply with the requirements of the local authority having jurisdiction.

1.6.2 The Contractor shall obtain all necessary permits and pay all fees required for permits and inspections.

1.7 TESTS AND SETTINGS

1.7.1 The Contractor shall test systems and equipment furnished under DIVISION 16 and repair or replace all defective work and equipment. Refer to the individual equipment sections for additional specific testing requirements.

1.7.2 The Contractor shall make adjustments to the systems and instruct the Engineer's personnel in the proper operation of the systems.

1.7.3 In addition to the specific testing requirements listed in the individual Sections, the following minimum tests and settings shall be performed. Submit test reports upon completion of testing in accordance with SECTION 01330 – SUBMITTAL PROCEDURES.

1.7.3.1 Mechanical inspection, testing, and settings of circuit breakers, disconnect switches, motor starters, overload relays, control circuits, and equipment for proper operation.

1.7.3.2 The Contractor shall check the full load current draw of each motor. Where power factor correction capacitors are provided the capacitor shall be in the circuit at the time of the measurement. The Contractor shall check ampere rating of thermal overloads for motors and submit a typed record to the Engineer of the same, including MCC cubicle location and driven load designation, motor service factor, horsepower, and Code letter. If incorrect thermal overloads are installed replace same with the correct size overload.

1.7.3.3 The Contractor shall check power and control power fuse ratings. Replace fuses if they are found to be of the incorrect size.

1.7.3.4 The Contractor shall check settings of the motor circuit protectors. Adjust settings to lowest setting that will allow the motor to be started when under load conditions.

1.7.3.5 The Contractor shall check motor nameplates for correct phase and voltage. Check bearings for proper lubrication.

1.7.3.6 The Contractor shall check rotation of motors prior to testing the driven load. Disconnect the driven equipment if damage could occur due to wrong rotation. If the rotation is incorrect for the driven equipment correct motor connections at the motor terminal box.

1.7.3.7 The Contractor shall check interlocking, control, and instrument wiring for each system and/or part of a system to prove that the system will function properly as indicated by control schematic and wiring diagrams.

1.7.3.8 The Contractor shall inspect each piece of equipment in areas designated as HAZARDOUS to ensure that equipment of proper rating is installed.

1.7.3.9 The Contractor shall verify all terminations at transformers, equipment, panels, and enclosures by producing a 1, 2, 3 rotation on a phase sequenced motor when connected to "A," "B," and "C" phases.

1.7.3.10 The Contractor shall check all wire and cable terminations. The Contractor shall verify to the Engineer, connections meet the equipments torque requirements.

1.7.3.11 The Contractor shall field set all transformer taps as required to obtain the proper secondary voltage.

1.7.3.12 Infrared hot spot inspection shall be made of all electrical equipment including but not limited to panelboards, transformers, switches, power and control panels, etc. This shall be done under representative load conditions before the equipment is used by the Government and again 3 months before expiration of the 1-year warranty period.

1.7.4 Testing shall be scheduled and coordinated in writing with the Engineer at least 2 weeks in advance. The Contractor shall provide qualified test personnel, instruments, and test equipment. The Contractor shall provide certified calibration sheets including dates for all equipment to be used for testing with notice of scheduled testing. Calibration sheets shall also indicate that the units have been calibrated within 6 months of the testing date. The Contractor shall have qualified personnel present during the testing.

1.8 INTERPRETATION OF DRAWINGS

1.8.1 The approved drawings are not intended to show exact locations of conduit runs. The Contractor shall coordinate the conduit installation with other trades and the actual supplied equipment.

1.8.2 The Contractor shall install each 3-phase circuit in a separate conduit unless otherwise shown on the approved drawings.

1.8.3 Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.

1.8.4 Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.

1.8.5 The Contractor shall verify the exact locations and mounting heights of lighting fixtures, switches, and receptacles prior to installation. Any adjustments required in the field shall be provided at no additional cost to the Government and coordinated and approved by the Engineer.

1.8.6 Except where dimensions are shown, the locations of equipment, fixtures, outlets, and similar devices shown on the approved drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer during construction. The Contractor shall obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer, and furnish all labor and materials necessary to complete the work in an approved manner.

1.8.7 The Contractor shall furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the approved equipment at no additional cost to the Government.

1.8.8 Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment, and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.

1.8.9 Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by ½-inch spacers to provide a clearance between wall and equipment.

1.8.10 All floor mounted electrical equipment shall be placed on 4-inch thick (3/4-inch, 45 degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.

1.8.11 The Contractor shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, architectural, and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the Contractor without additional expense to the Government. In case interference develops, the Engineer is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.

1.8.12 Raceways and conductors for lighting, switches, receptacles, and other miscellaneous low voltage power and signal systems as specified are not shown on the Contract Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the approved drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in all process spaces. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

1.9 PHASE BALANCING

1.9.1 Circuits on motor control centers and panelboards shall be field connected to result in evenly balanced loads across all phases.

1.9.2 Field balancing of circuits shall not alter the conductor color-coding requirements.

1.10 SIZE OF EQUIPMENT

1.10.1 The Contractor shall investigate each space in the structure through which equipment must pass to reach its final location. The Contractor shall coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.

1.10.2 The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

1.11 RECORD DRAWINGS

1.11.1 As the work progresses, legibly record all field changes on a set of Project approved drawings, hereinafter called the "Record Drawings."

1.11.2 Record Drawings shall accurately show the installed condition of the following items:

1.11.2.1 One-line Diagram(s).

1.11.2.2 Equipment elevations (front views).

1.11.2.3 Raceways and pullboxes.

1.11.2.4 Conductor sizes and conduit fills.

1.11.2.5 Panel Schedule(s).

1.11.2.6 Control Wiring Diagram(s).

1.11.2.7 Lighting Fixture Schedule(s).

1.11.2.8 Lighting fixture, receptacle, and switch outlet locations.

1.11.2.9 Underground raceway and duct bank routing.

1.11.2.10 Plan view, sizes and locations of switchgear, distribution transformers, substations, motor control centers, and panelboards.

1.11.3 The Contractor shall submit a schedule of control wiring raceways and wire numbers, including the following information:

1.11.3.1 Circuit origin, destination, and wire numbers.

1.11.3.2 Field wiring terminal strip names and numbers.

1.11.4 In addition to the schedule, the Contractor shall provide point-to-point connection diagrams showing the same information submitted in the schedule of control wiring raceways including all designations and wire numbers.

1.11.5 The Contractor shall submit the Record Drawings, schedule of control wiring raceways and wire numbers, and the point-to-point connection diagrams to the Engineer. The schedule of control wiring raceways and wire numbers, and the point-to-point connection diagrams shall be computer generated (i.e. no hand-written or drawn schedules, drawings, or diagrams will be accepted).

1.12 EQUIPMENT INTERCONNECTIONS

1.12.1 The Contractor shall review shop drawings of equipment furnished under other Divisions and prepare coordinated wiring interconnection diagrams or wiring tables. Submit copies of wiring diagrams or tables with the Record Drawings.

1.12.2 The Contractor shall furnish and install all equipment interconnections.

1.13 MATERIALS AND EQUIPMENT

1.13.1 Materials and equipment shall be new, except where specifically identified on the approved drawings to be re-used.

1.13.2 Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed.

1.13.3 The Contractor shall warrantee all equipment in accordance with the individual equipment sections.

1.14 EQUIPMENT IDENTIFICATION

1.14.1 The Contractor shall identify equipment (disconnect switches, separately mounted motor starters, control stations, etc.) furnished under DIVISION 16 with the name of the equipment it serves. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc., shall have nameplate designations as shown on the approved drawings.

1.14.2 Nameplates shall be engraved, laminated plastic, not less than 1/16 inch thick by ¾ inch by 2½ inches with 3/16-inch high white letters on a black background.

1.14.3 Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate, the nameplate shall be permanently fastened to the adjacent mounting surface. Cemented nameplates shall not be drilled.

1.14.4 All voltages (e.g., 480 volts, etc.) within pull boxes, junction boxes etc. shall be identified on the front exterior cover. Signs shall be red background with white engraved lettering, lettering shall be a minimum of 1 inch high.

1.15 SAFETY REQUIREMENTS

The Contractor shall make every effort to keep all employees and/or subcontractors aware of the danger inherent in working in dangerous proximity to the existing power lines. The minimum recommended precautionary measures are as follows:

1.15.1 The Contractor shall make sure that all persons responsible for operating cranes, draglines, and other mobile equipment have a copy of, and are familiar with the State Department of Commerce Regulations for Use of Cranes, Draglines, and Similar Equipment Near Power Lines, as well as the U. S. Department of Labor OSHA Regulations, before commencing operation of said equipment.

1.15.2 All cranes, draglines, and other mobile equipment shall have attached to them the black and yellow Department of Commerce warning signs required by the said Regulations of State Department of Commerce.

1.15.3 All employees on the ground shall be warned of the danger of holding on to or touching a cable or other piece of equipment or machinery that is located or working close to any overhead power line.

1.15.4 If, during the course of construction, it becomes necessary for the Contractor, or Subcontractor, and their employees, to operate cranes, draglines, or their mobile equipment, in dangerous proximity of any overhead power lines, or in such a manner that such equipment might come close to any overhead power lines, the Contractor shall give the Power Company or overhead power line owner prior notice of such proposed operation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SLEEVES AND FORMS FOR OPENINGS

3.1.1 The Contractor shall provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. The Contractor shall locate all necessary slots for electrical work and form before concrete is poured.

3.1.2 Exact locations are required for stubbing-up and terminating concealed conduit. The Contractor shall obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.

3.1.3 Where setting approved drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

3.1.4 The Contractor shall seal all openings, sleeves, penetration, and slots.

3.2 CUTTING AND PATCHING

3.2.1 Cutting and patching shall be done in a thoroughly workmanlike manner. Saw cut concrete and masonry prior to breaking out sections.

3.2.2 The Contractor shall core drill holes in existing concrete floors and walls as required.

3.2.3 The Contractor shall install work at such time as to require the minimum amount of cutting and patching.

3.2.4 The Contractor shall not cut joists, beams, girders, columns, or any other structural members.

3.2.5 The Contractor shall cut opening only large enough to allow easy installation of the conduit.

3.2.6 Patching to be of the same kind and quality of material as was removed.

3.2.7 The completed patching work shall restore the surface to its original appearance or better.

3.2.8 Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.

3.2.9 The Contractor shall remove rubble and excess patching materials from the premises.

3.2.10 When existing conduits are cut at the floor line or wall line, they shall be filled with grout of suitable patching material.

3.3 INSTALLATION

3.3.1 Any work not installed according to the approved drawings and this Division or without approval by the Engineer shall be subject to change as directed by the Engineer. No extra compensation will be allowed for making these changes.

3.3.2 Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If an apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be replaced at no additional cost to the Government, the damaged unit(s) or systems shall remain on site and returned to the manufacturer after the replacement unit(s) or systems have been delivered to the site. Under no circumstances will electrical equipment damaged by water be rehabilitated or repaired, new equipment shall be supplied and all cost associated with replacement shall be borne by the Contractor.

3.3.3 Equipment that has been damaged shall be replaced or repaired by the equipment manufacturer, at the Engineer's discretion.

3.3.4 The Contractor shall repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted at no additional cost to the Government.

END OF SECTION

SECTION 16110

RACEWAYS, BOXES, FITTINGS AND SUPPORTS

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish and install complete raceway systems as specified herein.

1.1.2 Home runs indicated are to assist the contractor in identifying raceways to be installed concealed or exposed. Raceways to be installed exposed shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with pipes, cranes and hoists, lighting fixtures, doors and hatches. Raceways indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

1.1.3 Raceways and conductors including but not limited to raceways and conductors: between lighting, switches, receptacles, except where they are required to pass through a restricted or designated spaces. Raceways and conductors shall be provided for complete and operating systems. Raceways to be run exposed shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC equipment, cranes and hoists, lighting fixtures, doors and hatches, etc. Raceways to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

1.1.4 Furnish all labor, materials, equipment, accessories and components and install a complete seismic restraint and support system for raceway systems.

1.1.4.1 All supports, hangers, bracing and appurtenances shall conform to the latest applicable requirements of the New York State Building Code except as supplemented or modified by the requirements specified in this Section.

1.1.5 The electrical subcontractor shall engage the services of an independent professional engineer registered in the State of New York, with specific experience in the design of seismic restraints and supports for electrical supporting systems hereinafter referred to as support engineer.

1.2 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.2.1 Product Data; Product Data; FIO

The Contractor shall submit manufacturers' names and product designation or catalog numbers with marked cut sheets of all materials specified.

1.2.2 Samples; Samples; FIO

The Contractor shall submit the type of hanger and/or support, location, support reaction transmitted to the structure and type of anchor and other supporting appurtenance including structural fasteners.

1.3 REFERENCES

Raceways, boxes and fittings shall comply with the requirements of the National Electrical Manufacturers Association (NEMA), American National Standards Institute (ANSI) and Underwriters Laboratories (UL).

PART 2 PRODUCTS

2.1 RACEWAYS AND FITTINGS

2.1.1 Steel Conduit and Fittings

2.1.1.1 Rigid metal conduit (GRS), couplings, factory elbows and fittings shall be heavy wall steel tubing with a hot-dipped galvanized finish inside and out after threading and shall comply with ANSI C 80.1 and UL/6.

2.1.1.2 Rigid metal conduit fittings shall be of the threaded type, and shall be steel or malleable iron, with a hot-dipped galvanized finish. Threadless fittings and split couplings are not allowed except in specific applications as approved by the Engineer.

2.1.2 Aluminum Conduit and Fittings

Rigid Aluminum conduit, couplings, factory elbows and fittings shall be 6063 alloy and shall comply with ANSI C80.5.

2.1.3 PVC Coated Rigid Steel Conduit and Fittings

2.1.3.1 PVC coated rigid steel conduit shall be heavy wall steel tubing with a hot-dipped galvanized finish inside and out after threading with a minimum 0.040-in thick, polyvinyl chloride coating permanently bonded to it and an internal chemically cured urethane or enamel coating. The rigid steel conduit shall comply with ANSI C80.1 and UL/6 prior to coating.

2.1.3.2 PVC coated couplings, factory elbows and fitting shall be furnished with a PVC coating bonded to steel the same thickness as used on the PVC coated conduit. The ends of all couplings, fittings, etc. shall have a minimum of one pipe diameter in length of PVC overlap.

2.1.4 Non Metallic Conduit and Fittings

2.1.4.1 PVC conduit shall be rigid polyvinyl chloride schedule 80. Rigid PVC conduit up to trade sizes 3-1/2-in shall comply with NEMA TC-2 and UL/651 and shall be sunlight resistant, rated for use with 90 degree C conductors in exposed, direct burial or concrete encased applications. Underground utility duct, 4-in trade size and above, shall be high density polyethylene (HDPE) Schedule 80 conduit encased in concrete, rated for use with 90 degree C conductors and shall comply with NEMA TC-8 and ASTM F512.

2.1.4.2 Connectors, couplings, fittings and ancillary materials shall be supplied by the conduit manufacturer.

2.1.5 Liquid-tight Flexible Metal Conduit, Couplings and Fittings

2.1.5.1 Liquid-tight flexible metal conduit shall be square locked, galvanized steel flexible conduit with a moisture proof, flame resistant, polyvinyl chloride jacket, for use with rigid metal conduit systems.

2.1.5.2 Liquid-tight conduit fittings shall be hot-dipped mechanically galvanized, positive grounding, screw in type. Provide external bonding lugs on sizes 1-1/4-in and larger. Box connectors shall have insulated throats.

2.2 BOXES AND FITTINGS

2.2.1 Wet Location Boxes and Fittings

2.2.2.1 NEMA 4X terminal boxes, junction boxes, pull boxes, etc, shall be sheet Type 316 stainless steel. Boxes shall have continuously welded seams and mounting feet. Welds shall be ground smooth. Boxes shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel clamps. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 Amps, 600 Volt.

2.2.2.2 Cast or malleable iron device boxes shall be Type FD. Boxes and fittings shall have cadmium-zinc finish with cast covers and stainless steel screws.

2.2.2.3 Cast aluminum device boxes shall be Type FD. Boxes and fittings shall be copper free aluminum with cast aluminum covers and stainless steel screws

2.2.3 Corrosive Location Boxes

2.2.3.1 NEMA 4X PVC coated outlet boxes shall be used with PVC coated conduit shall be furnished with a PVC coating bonded to the metal, the same thickness as used on the coated steel.

2.2.3.2 NEMA 4X terminal boxes, junction boxes and pull boxes shall be fiberglass reinforced plastic with stainless steel hardware and gasketed covers. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 Amps, 600 Volt.

2.2.4 Miscellaneous Fittings:

2.2.4.1 Flexible couplings.

2.2.4.2 Conduit hubs.

2.2.4.3 Conduit wall seals for cored holes.

2.2.4.4 Conduit wall and floor seals for sleeved openings.

2.2.4.5 Combination expansion-deflection fittings embedded in concrete.

2.2.4.6 Combination expansion-deflection fittings.

2.2.4.7 Conduit sealing bushings.

2.2.4.8 Grounding bushings shall be malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.

2.3 HARDWARE

2.3.1 Conduit Mounting Equipment

2.3.1.1 In dry indoor areas, hangers, rods, backplates, beam clamps, channel, etc shall be galvanized iron or steel.

2.3.1.2 PVC coated steel channel with stainless steel hardware shall be used in areas designated "WET" or "CORROSIVE". Fiberglass channel shall be resistant to the chemicals present in the area in which it is used.

2.3.1.3 Furnish any and all necessary supports, brackets, conduit sleeves, racks and bracing as required. All boxes and hardware shall be galvanized zinc plated steel except that stainless steel shall be used in areas designated as "WET" or "CORROSIVE".

2.3.2 Conduit Identification Plates

Conduit identification plates shall be embossed stainless steel with stainless steel band, permanently secured to the conduit without screws.

2.3.3 Wall and Floor Slab Opening Seals

Wall and floor slab openings shall be sealed with a UL approved expending material which equals or exceeds the fire rating of the wall or floor construction.

2.3.4 Cold Galvanizing Compound

Cold galvanizing compound shall be an Organic Zinc-Rich coating containing 95% metallic zinc, by weight in the dried film; recognized under the Component Program of Underwriter's Laboratories, Inc. as an equivalent to hot-dip galvanizing; conforming to Federal Specification DOD-P-21035A (formally MIL-P-21035A) for repair of hot-dip galvanizing.

2.3.5 Conduit Supports

2.3.5.1 Trapezes

2.3.5.1.1 In dry indoor areas, beams, channels, struts, hangers, bracing, rods, beam clamps, accessories and components shall be galvanized steel.

2.3.5.1.2 PVC coated steel beams, channels, struts or fiberglass beams, channels, struts with stainless steel hangers, bracing, rods, beam clamps, accessories and components shall be used in areas designated "WET", "DAMP" and "CORROSIVE" where indicated and in outdoor locations. Fiberglass channels shall be resistant to the chemicals present in the area in which it is used.

2.3.5.2 Flush Mounted Supports

2.3.5.2.1 In dry indoor areas, channels, struts, accessories and components shall be galvanized steel.

2.3.5.2.2 PVC coated steel channels, struts or fiberglass channels, struts with stainless, accessories and components shall be used in areas designated "WET", "DAMP" and "CORROSIVE" and in outdoor locations. Fiberglass channels, struts shall be resistant to the chemicals present in the area in which it is used.

2.3.5.3 Conduit Racks

2.3.5.3.1 In dry indoor areas, conduit racks, accessories and components shall be galvanized steel.

2.3.5.3.2 PVC coated steel conduit racks or fiberglass conduit racks with stainless, accessories and components shall be shall be used in areas designated "WET", "DAMP" and "CORROSIVE" where indicated and in outdoor locations. Fiberglass channels shall be resistant to the chemicals present in the area in which it is used.

2.3.5.4 Conduit Hangers

2.3.5.4.1 In dry indoor areas, conduit clamps, rods, beam clamps, bracing, accessories and components shall be galvanized steel.

2.3.5.4.2 Stainless steel conduit clamps, rods, beam clamps, bracing, accessories and components shall be shall be used in areas designated "WET", "DAMP" and "CORROSIVE" and in outdoor locations.

2.3.5.5 Adjustable steel and plastic band hangers, adjustable band hangers, adjustable swivel ring hangers and J-hangers shall not be allowed.

2.3.5.6 Design of supplemental structural steel required for attachment to the building structural support system shall be the full responsibility of the Support Engineer.

PART 3 EXECUTION

3.1 RACEWAY APPLICATIONS

3.1.1 Refer to Table 16110-1 for specific raceway application requirements.

TABLE 16110-1
Raceway Application Guidelines

Location/Circuit Type	Raceway Type
All locations - raceways containing circuits above 600 Volts.	▫ Exposed - Galvanized rigid steel (GRS) conduit. ▫ Concealed - Do not embed within structure. If this is not possible, use Schedule 40 PVC conduit. ▫ Underground - Schedule 80 PVC conduit in concrete reinforced ductbank. ▫ Avoid running through corrosive locations.
All locations ▫ Class 2 and 3 signal wiring and 4-20 mA instrumentation cables, non-fiber (copper) data highway. ▫ Fire alarm, security, and communications system wiring.	▫ Exposed – Use galvanized rigid steel (GRS) conduit in hazardous areas, areas designated as wet and outdoor areas. ▫ Concealed - Galvanized rigid steel (GRS) conduit. ▫ Underground - PVC conduit in concrete reinforced ductbank.
Corrosive areas - chemical storage and handling areas, underground vaults, within tanks or clearwells, filter pipe galleries and locations where designated corrosive.	▫ Exposed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 80 PVC for sized 3/4 and 1-in. Schedule 40 PVC above 1-in. ▫ Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 40 PVC conduit when embedded within concrete floor slabs or structures.
Outdoor areas - all locations.	▫ Exposed conduit for power wiring, lighting, switch, and receptacle circuits – galvanized rigid steel or rigid aluminum. PVC conduit shall not be used exposed. ▫ Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 40 PVC conduit when embedded within concrete structures.

1.2 All conduit of a given type shall be the product of one manufacturer.

3.1.3 Refer to SECTION 16600 - ELECTRICAL - GENERAL PROVISIONS for underground applications.

3.2 BOX APPLICATIONS

3.2.1 Unless otherwise specified herein, all boxes shall be metal.

3.2.2 Exposed switch, receptacle and lighting outlet boxes and condulet fittings shall be cast or malleable iron, except that cast aluminum shall be used with aluminum conduit and non-metallic PVC shall be used with PVC.

3.2.3 Concealed switch, receptacle and lighting outlet boxes shall be pressed steel.

3.2.4 Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in SECTION 16000 - ELECTRICAL - GENERAL PROVISION.

3.2.5 Boxes flush in block, walls shall be located at a course line and provided with square tile covers. Flush boxes shall not project beyond the finished surfaces nor shall surfaces project more than 1/8-in beyond the box enclosure. Wiring devices located in close proximity to each other shall be installed in one solid gang box with single cover.

3.2.6 All conduit bodies and pulling outlets shall comply with NEC wire bending space requirements. Mogul type fittings shall be used for sizes 2-1/2-in and larger.

3.3 FITTINGS APPLICATIONS

3.3.1 Combination expansion-deflection fittings shall be used where exposed rigid metal conduits cross structure expansion joints or in straight runs where expansion is anticipated. Combination expansion-deflection fittings shall be installed where embedded rigid metal conduit cross structural expansion joints. Provide bonding jumpers around fittings.

3.3.2 All underground conduit penetrations at walls or other structures shall be sealed watertight. Conduit wall seals and sleeves shall be used in accordance with the manufacturer's installation instructions.

3.3.3 Conduit sealing bushings shall be used to seal conduit ends exposed to the weather.

3.3.4 Insulated throat grounding bushings shall be used where specified herein, in SECTION 16660 - GOUNDING SYSTEM and where conduits stub up into electrical equipment such as panelboards, etc.

3.4 INSTALLATION

3.4.1 No conduit smaller than 3/4-in electrical trade size shall be used, nor shall any have more than the equivalent of three 90 degree bends in any one run. Pull boxes shall be provided as required by the NEC after every 270 degrees of bends and for straight run not to exceed 200 feet or as directed.

3.4.2 No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

3.4.3 All conduit which may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc, shall be arranged to drain away from the equipment served. If conduit drainage is not possible, conduit seals shall be used to plug the conduits. The ends of all conduits shall be temporarily plugged to exclude dust, moisture and debris from entering during construction.

3.4.4 Conduit ends exposed to the weather shall be sealed with conduit sealing bushings.

3.4.5 Conduits noted as spare shall be capped or plugged at both ends with easily removable fittings.

3.4.6 Conduit terminating in NEMA 4, and 4X enclosures shall be terminated with Myers type conduit hubs.

3.4.7 Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings.

3.4.8 Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings.

3.4.9 Conduits shall be installed using threaded fittings except for PVC or EMT.

3.4.10 The use of running threads is prohibited. Where such threads are necessary, a 3-piece union shall be used.

3.4.11 All conduits entering or leaving a motor control center, switchboard or other multiple compartment enclosure shall be stubbed up into the bottom horizontal wireway or other manufacturer's designated area, directly below the vertical section in which the conductors are to be terminated. The 3-in extension of conduit above the floor slab or concrete equipment pad may be reduced to a dimension that suits the equipment manufacturer's installation requirements if the 3-in stub-up interferes with the equipment being provided.

3.4.12 Rigid galvanized steel conduits buried in earth shall be completely painted with bitumastic.

3.4.13 Rigid galvanized steel conduits which have been field cut and threaded shall be painted with cold galvanizing compounds.

3.4.14 PVC coated rigid galvanized steel conduit shall be used for elbows at risers at the utility pole for electrical and telephone service conduits. Rigid galvanized steel conduit shall be used at utility pole for electrical and telephone service and fire alarm conduits to a height of 10-

ft above finished grade. Furnish and install weather heads at service pole riser if required by utility company.

3.4.15 PVC coated rigid galvanized steel elbows shall be used for pad-mounted transformer stub-ups.

3.4.16 Liquid-tight flexible metal conduit shall be used for all motor terminations, the primary and secondary of transformers, generator terminations and other equipment where vibration is present or may require removal. Non-metallic flexible conduit can be used with rigid PVC conduit systems.

3.4.17 Aluminum fittings and boxes shall be used with aluminum conduit. Aluminum conduit shall not be imbedded in concrete. Aluminum conduit shall be isolated from other metals with plastic sleeves or plastic-coated hangers. Strap wrenches shall be used for tightening aluminum conduit.

3.4.18 PVC coated rigid steel conduit shall be used as a transition section where concrete embedded conduit stubs out of floor slabs or through below grade walls or where conduit installed under building slabs on grade stub out of floors. The PVC coated rigid steel conduit shall extend a minimum of 3-in into and out of the floor slab, concrete pad, or wall to allow for proper threading of the conduit.

3.4.19 PVC conduit to non-metallic box connections shall be made with PVC socket to male thread terminal adapters with neoprene O-ring and PVC round edge bushings.

3.4.20 PVC conduit shall be supported with non-metallic clamps, PVC coated steel racks and stainless steel hardware.

3.4.21 Expansion fittings shall be used on exposed runs of PVC conduit where required for thermal expansion. Installation and number of fittings shall be as recommended by manufacturer.

3.4.22 PVC boxes, conduit fittings, etc, with integral hubs shall be solvent welded directly to the PVC conduit system.

3.4.23 Non-metallic boxes with field drilled or punched holes shall be connected to the PVC conduit system with threaded and gasketed PVC Terminal Adapters.

3.4.24 Conduit supports, other than for underground raceways, shall be spaced at intervals not exceeding the distance required by the NEC to obtain rigid construction.

3.4.25 Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on fabricated channel trapeze type racks with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc, shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.

3.4.26 Conduit Supports (Other than Underground Raceways)

3.4.26.1 Trapezes

3.4.26.1.1 Conduit support trapezes shall be vertically supported every 10-ft or less, as required to obtain rigid conduit construction.

3.4.26.1.2 Lateral seismic restraints (Sway Bracing) shall be spaced 30-ft or less.

3.4.26.1.3 Horizontal seismic restraints shall be spaced at 40-ft or less. There shall be at least one horizontal restraint per horizontal run.

3.4.26.1.4 Attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used for seismic restraint only.

3.4.26.1.5 Attachment to concrete shall be cast-in-place inserts, cast-in place welded plates with welded studs or stainless steel adhesive anchors.

3.4.26.2 Flush Mounted Supports

3.4.26.2.1 Support shall be spaced 10-ft or less, as required to obtain rigid conduit construction.

3.4.26.2.2 Attachment to concrete shall be with cast-in-place inserts, cast-in place welded plates with welded studs or stainless adhesive anchors.

3.4.26.3 Conduit Racks

3.4.26.3.1 Support shall be spaced 10-ft or less, as required to obtain rigid conduit construction.

3.4.26.3.2 Horizontal seismic restraints shall be spaced at 30-ft or less.

3.4.26.3.3 Attachment to concrete shall be with cast-in-place inserts, cast-in place welded plate with welded studs or stainless adhesive anchors.

3.4.26.4 Conduit Hangers

3.4.26.4.1 Conduit hangers shall be vertical supported 10-ft or less, as required to obtain rigid conduit construction.

3.4.26.4.2 Lateral seismic restraints (Sway Bracing) shall be spaced 20-ft or less.

3.4.26.4.3 Horizontal seismic restraints shall be spaced at 30-ft or less. There shall be at least one horizontal restraint per horizontal run.

3.4.26.4.4 Attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used for seismic restraint only.

3.4.26.4.5 Attachment to concrete shall be cast-in-place inserts, cast-in place welded plates with welded studs or stainless steel adhesive anchors.

3.4.26.5 All reinforcing bars shall be located by the Electrical Subcontractor with the use of a rebar locator prior to installing adhesive capsule type anchors. Mark the location of all reinforcing bars in an area bounded by a line drawn at least 18-in from the edge of the support bearing/weld plates on all four sides of the bearing/weld plates prior to fabricating and installing bearing/weld plates.

3.4.26.6 Where interference occurs, adjust anchor locations to clear reinforcing bars and alter support configuration at no additional cost to the Authority.

3.4.27 Miscellaneous steel for the support of fixtures, boxes, transformers, starters, contactors, panels and conduit shall be furnished and installed. Channel supports shall be ground smooth and fitted with plastic end caps.

3.4.28 Steel channels, flat iron and channel iron shall be furnished and installed for the support of all electrical equipment and devices, where required, including all anchors, inserts, bolts, nuts, washers, etc, for a rigid installation. Channel supports shall be ground smooth and fitted with plastic end caps.

3.4.29 Provide sway braces for cable trays. Sway braces shall be U-channel supports installed at a 45 degree angle from the tray and anchored to the concrete ceiling structure or structural support system. Braces shall be provided on 20-ft spacing centers. Alternate the direction of the bracing supports.

3.4.30 Conduits terminating at a cable tray shall be supported independently from the cable tray. Provide a conduit support within 1-ft of the cable tray. The weight of the conduit shall not bear on the cable tray.

3.4.31 All conduits on exposed work, within partitions and above suspended ceilings, shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduits shall be run perfectly straight and true.

3.4.32 Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke in accordance with UL requirements. The sealing method shall have a UL fire rating, which equals or exceeds the fire rating of the wall or floor construction.

3.4.33 Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.

3.4.34 Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc, shall be sealed with "Duxseal" or seal fitting to prevent the accumulation of condensation.

3.4.35 Mandrels shall be pulled through all new conduits 2-in in diameter and larger prior to installing conductors.

3.4.36 3/16-in polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment. Conduit noted as spare shall be capped or plugged at both ends with easily removable fittings.

3.4.37 Where no type or size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of NEC Article 314. Enclosure type and material shall be as specified herein.

3.4.38 Pull or junction boxes shall be furnished and installed in every 200 feet of straight conduit runs or in runs where more than the equivalent of four 90 degree bends occur or at any point necessary for wire pulling and splicing. Splices shall not be made in pulling elbows.

3.4.39 A conduit identification plate shall be installed on all power, instrumentation, alarm and control conduits at each end of the run and at intermediate junction boxes, manholes, etc. Conduit plates shall be installed before conductors are pulled into the conduits. Exact identification plate location shall be coordinated with the Engineer at the time of installation to provide uniformity of placement and ease of reading.

3.4.40 Place inner duct in the conduit and allow to rest in place for a minimum of 72 hours prior to cutting each end to length.

3.4.41 Place the correct number of maximum sized inner ducts for the conduit with minimum 1/8-in clearance.

END OF SECTION

SECTION 16141

WIRING DEVICES

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish all labor, materials, equipment and install wiring devices as shown on the Drawings and as specified herein.

1.1.2 Provide all interconnecting conduit and branch circuit wiring for receptacle circuits in accordance with the NEC.

1.2 RELATED WORK

Outlet boxes are included in SECTION 16110 - RACEWAYS, BOXES, FITTINGS, AND SUPPORTS.

1.3 SUBMITTALS

Refer to SECTION 16000 - ELECTRICAL - GENERAL PROVISIONS.

1.4 REFERENCES

Wiring devices shall comply with the requirements of the National Electric Code (NEC) and shall be Underwriters Laboratories (UL) labeled.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Wall switches shall be heavy duty, specification grade, toggle action, flush mounting quiet type. All switches shall conform to the latest revision of Federal Specification WS 896. Wall switches shall be suitable for the area classification indicated.

2.1.2 Explosion-proof single pole factory sealed switches shall be for 20 Amps, 120/277 volts, mounted in copper free aluminum or malleable iron cast boxes.

2.1.3 Receptacles shall be heavy duty, specification grade. Receptacles shall conform to Fed Spec WC596-F.

2.1.4 Device Plates

2.1.4.1 Plates for indoor flush mounted devices shall be of the required number of gangs for the application involved and shall be as follows:

2.1.4.1.1 Administration type buildings: Smooth, high impact nylon of the same manufacturer and color as the device. Final color shall be as selected by the Architect.

2.1.4.1.2 Where permitted in other areas of the plant, flush mounted devices in cement block construction shall be Type 302 high nickel (18-8) stainless steel of the same manufacturer as the devices.

2.1.4.2 Plates for indoor surface mounted device boxes shall be cast metal of the same material as the box.

2.1.4.3 Oversized plates shall be installed where standard plates do not fully cover the wall opening.

2.1.4.4 Device plates for switches mounted outdoors or indicated as weatherproof shall be gasketed, cast aluminum with provisions for padlocking switches "On" and "Off".

2.1.4.5 Multiple surface mounted devices shall be ganged in a single, common box and provided with an adapter, if necessary, to allow mounting of single gang device plates on multigang cast boxes.

2.1.4.6 Engraved device plates shall be provided where required.

2.1.4.7 Weatherproof, gasketed cover for GFI receptacle mounted in a FS/FD boxes.

2.1.5 Three Phase Power Receptacles

2.1.5.1 Three phase power receptacles and plugs shall be rated for the voltage and current ratings of the connected load unless otherwise shown on the Drawings.

2.1.5.2 Receptacles and plug housings shall be constructed of copper free aluminum listed to UL Standard 498 for watertight construction. Hardware shall be stainless steel.

2.1.5.3 Performance:

2.1.5.3.1 Maximum working voltage: 600 Volts RMS.

2.1.5.3.2 Dielectric withstand voltage: 3000 Volts.

2.1.5.3.3 Full load break capability at rated current.

2.1.5.3.4 5000 connect/disconnect cycles at rated voltage and current.

2.1.5.4 Furnish and install one mating plug with each receptacle.

2.1.5.5 Provide the following features:

2.1.5.5.1 Color coded by voltage.

2.1.5.5.2 One piece housing/angled backbox.

2.1.5.5.3 Shrouded pins.

2.1.5.5.4 Self closing gasketed cover.

2.1.5.5.5 Watertight cable entrances/stress relief grips.

2.1.5.5.6 Mating keys.

2.1.6 Interlocked Three Phase Power Receptacles

2.1.6.1 Interlocked three phase power receptacles shall include a combination receptacle and a mechanically interlocked disconnect switch. The two units shall be interlocked to prevent removal or insertion of the plug unless the switch is in the OFF position.

2.1.6.2 Provide a matching plug for every unit furnished.

2.1.6.3 Switch, power receptacle and mating plug shall be constructed of copper free aluminum.

2.1.6.4 Assemble shall be listed to UL Standard 498 for watertight- construction.

2.1.6.5 Hardware shall be stainless steel.

2.1.6.6 Performance:

2.1.6.6.1 Maximum working voltage: 600 Volts RMS

2.1.6.6.2 Dielectric withstand voltage: 3000 Volts

2.1.6.6.3 Full load break capability at rated current

2.1.6.6.4 5000 connect/disconnect cycles at rated voltage and current

2.1.6.7 Provide the following features:

2.1.6.7.1 Color coded by voltage

2.1.6.7.2 One piece housing/angled backbox

2.1.6.7.3 Shrouded pins

2.1.6.7.4 Self closing gasketed cover

2.1.6.7.5 Watertight cable entrances/stress relief grips

2.1.6.7.6 Mating keys

2.1.6.8 The disconnect switch shall be unfused with ratings as hereinbefore specified. Provide lockout provisions on the disconnect switch handle.

2.1.7 Poke-Thru Service Fittings

2.1.7.1 Poke-thru service fittings shall be installed in a 2-in core drilled hole, fit floor thicknesses of 2-1/2-in to 7-in and be fire rated.

2.1.7.2 Poke-thru service fittings shall be barriered to handle both high and low tension services and be designed for both new construction and building retrofit.

2.1.7.3 Service fitting heads shall each contain a 20 Amp, 125 Volt, 2 Pole, 3 Wire duplex receptacle on one side and provisions for up to 2-25 pair telephone cables on the remaining side.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Switch and receptacles outlets shall be installed flush with the finished wall surfaces in areas with stud frame and gypsum board construction, in dry areas with cement block construction or when raceways are shown as concealed on the Drawings.

3.1.2 Do not install flush mounted devices in areas designated DAMP, WET or WET/CORROSIVE on the Drawings. Provide surface mounted devices in these areas.

3.1.3 Provide weatherproof devices covers in areas designated WET or WET/CORROSIVE on the Drawings.

3.1.4 Convenience outlets shall be 15-in above the floor unless otherwise required.

3.1.5 Convenience outlets installed outdoors and in rooms where equipment may be hosed down shall be 18-in above floor or grade.

3.1.6 Switches and dimmer controls for lighting shall be mounted 48-in above the finished floor unless otherwise noted or required.

3.1.7 The location of all devices is shown, in general, on the Drawings and may be varied within reasonable limits so as to avoid any piping or other obstruction without extra cost, subject to the approval of the Engineer. Coordinate the installation of the devices for piping and equipment clearance.

END OF SECTION

SECTION 16191

MISCELLANEOUS ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish and install all miscellaneous equipment as specified herein.

1.1.2 This Section provides the requirements for miscellaneous equipment typically employed in a facility, however, not all components specified in this Section are necessarily utilized on this project.

1.2 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.2.1 Catalog Information; Product Data; EA

The Contractor shall submit detailed catalog information or drawings with sufficient detail to determine compliance with the Specifications including describing electrical and physical characteristics of all equipment specified.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the below standards, the revision in effect at the time of contract award shall apply.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1 Molded Case Circuit Breakers

NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies

NEMA ICS 6 Enclosures for Industrial Controls and Systems.

NEMA KS 1 Enclosed Switches

NEMA ST 20 Dry Type Transformers for General Applications

NEMA 250 Enclosures for Electrical Equipment

1.3.1 Equipment enclosures shall have NEMA ratings suitable for the location in which they are installed, as specified in SECTION 16000 - ELECTRICAL - GENERAL PROVISIONS.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Disconnect Switches

2.1.1.1 Disconnect switches shall be NEMA 4X heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat, and flange mounted operating handle unless otherwise noted. All current carrying parts shall be copper.

2.1.1.2 NEMA 4X enclosures shall be stainless steel.

2.1.1.3 NEMA 7 enclosures shall be cast aluminum.

2.1.1.4 Lugs shall be copper.

2.1.1.5 All exterior hardware shall be stainless steel.

2.1.2 Fused Disconnect Switches

2.1.2.1 Fused disconnect switches shall be NEMA 4X heavy-duty, quick-make, quick-break, visible blades, 600 Volt, 3 Pole with full cover interlock, interlock defeat, and flange mounted operating handle unless otherwise noted. All current carrying parts shall be copper.

2.1.2.2 Fuses shall be rejection type, 600 Volts, 200,000 A.I.C., dual element, time delay, Class RK-5, or equal as approved by the Engineer.

2.1.2.3 NEMA 4X enclosures shall be stainless steel.

2.1.2.4 NEMA 7 enclosures shall be cast aluminum.

2.1.2.5 Lugs shall be copper.

2.1.2.6 All exterior hardware shall be stainless steel.

2.1.3 Combination Magnetic Motor Starters

2.1.3.1 Motor starters shall be a combination motor circuit protector and contactor, 2 or 3 Pole, single or 3 Phase as required, 60 Hz, 600 Volt, magnetically operated, full voltage non-reversing unless otherwise shown on the approved drawings. NEMA sizes shall be as required for the horsepower furnished. Motor circuit protectors shall be molded case with adjustable magnetic trip only. They shall be specifically designed for use with magnetic motor starters. Motor circuit protectors shall be current limiting type, with additional current limiters if required.

Combination motor starters shall be fully rated for 100,000 Amps RMS symmetrical.

2.1.3.2 Two speed starters shall be for single or two winding motors as required by the actual motor furnished.

2.1.3.3 Each motor starter shall have a 120 Volt operating coil, and control power transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as required or as shown on the approved drawings. A minimum of one N.O. and one N.C. auxiliary contacts shall be provided in addition to the contacts as required for proper operation of the equipment furnished.

2.1.3.4 Overload relays shall be non-adjustable and manually reset.

2.1.3.5 Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time-delay fuses.

2.1.3.6 Built-in control stations and indicating lights shall be furnished as specified herein where required for proper operation of the equipment furnished.

2.1.3.7 NEMA 4X enclosures shall be stainless steel.

2.1.3.8 NEMA Type 7 enclosures shall be cast aluminum.

2.1.4 Control Stations and Indicators

2.1.4.1 Control stations shall be heavy-duty type, with full size (30.5mm) NEMA 4X or 7 operators, indicators, etc.

2.1.4.2 Indicators shall be full voltage and push-to-test type. Indicators located indoors shall be LED type and indicators located outdoors shall be incandescent lamp type.

2.1.4.3 NEMA 4X enclosures shall be stainless steel.

2.1.4.4 NEMA 7 enclosures shall be cast aluminum.

2.1.5 General Purpose Dry Type Transformers

2.1.5.1 Transformers shall be dry type, two-winding with kVA and voltage ratings as specified.

2.1.5.2 Four full capacity taps shall be furnished, two 2½ percent above and two 2½ percent below rated primary voltage.

2.1.5.3 Maximum temperature rise shall be 80 degrees C. Windings shall be copper.

2.1.5.4 Transformers shall be built in accordance with ANSI C89.2 and NEMA ST-20.

2.1.5.5 Transformers shall be provided in NEMA 1 enclosures unless otherwise specified or as required by SECTION 16000 - ELECTRICAL - GENERAL PROVISIONS. Where a NEMA 4X and/or stainless steel enclosure is required, the transformer shall be of the TENV type.

2.1.5.6 Transformers shall be furnished with hot dipped galvanized mounting hardware. Where a NEMA 4X and/or stainless steel enclosure is required, the hardware shall be 316 stainless steel.

2.1.5.7 Transformers shall be as approved by the Engineer.

2.1.6 Lightning and Surge Protection

2.1.6.1 Lightning and surge protection shall be as manufactured as approved by the Engineer. Models based on voltage and phase shall be:

- # TE1000HP 120/240 volt, single phase
- # TE1100HP 120 volt, single phase
- # TE1200HP 240 volt, single phase
- # TE2000HP 120/208 volt, three phase
- # TE3000HP 120/240 volt, three phase
- # TE4000HP 277/480 volt, three phase
- # TE5000HP 480 volt, three phase

2.1.7 Wireway

2.1.7.1 NEMA 1 wireway shall be gasketed, painted steel with stainless steel screw covers.

2.1.7.2 NEMA 4X wireway shall be 316 stainless steel with gasketed clamped covers.

2.1.7.3 NEMA 1 wireway shall be Square-Duct; NEMA 4X shall be Bulletin F-22 as approved by the Engineer.

2.1.8 Control Relays

2.1.8.1 Control relays shall be heavy-duty machine tool type, with 10 Amp, 300 Volt convertible contacts. Number of contacts and coil voltage shall be as required for proper operation of the actual equipment furnished. General use relays, Class 8501 Type X. Latching relays, Class 8501 Type X.

2.1.8.2 Time delay relays shall be pneumatic, 600 Volt, 20 Amp contacts, with calibrated knob operated adjustment and numerical time dial. On delay and off delay types and timing ranges shall be as required for proper operation of the actual equipment furnished. Relays shall be as approved by the Engineer.

2.1.9 Polyethylene Warning Tape

Warning tape shall be red polyethylene film, 6-inch minimum width.

2.1.10 Terminal Blocks

2.1.10.1 Terminal blocks shall be 600 Volt, channel mounted, with tubular screw and pressure plate.

2.1.10.2 Terminal blocks shall be approved by the Engineer.

2.1.11 JIC Boxes for GF Receptacles

2.1.11.1 JIC boxes shall be 6 inches x 6 inches x 4 inches aluminum continuous hinge clamp cover boxes, with Type L23 stainless steel fast operating JIC clamp, or equal as approved by the Engineer.

2.1.11.2 The Contractor shall install 1-1/2-inch bushings in bottom of box for cord and plug to pass through.

2.1.12 Equipment Mounting Stands

2.1.12.1 Equipment mounting stands shall be custom fabricated from 1/4-inch 316 stainless steel plate and 3-inch 316 stainless steel channel, unless otherwise specified.

2.1.12.2 All hardware shall be 316 stainless steel.

2.1.13 Emergency Shower Alarm Horn and Light

2.1.13.1 Emergency shower alarm horn shall be vibrating type for 120 Volts, 60 Hz.

2.1.13.2 Emergency shower alarm light shall be a flashing strobe unit with red fresnel globe, for use on a 120 Volts, 60 Hz power supply.

2.1.14 Intrinsically Safe Relays

Intrinsically safe relays shall be solid state type with 5 Amp output contacts, suitable for use on a 120 Volt, 60 Hz power supply and shall be FM approved for pilot devices in Class I, Division 1, Group D hazardous atmospheres.

2.1.15 Beacon Alarm Light

Beacon alarm light for building exterior mounting shall be flush mounted, weatherproof construction and have a 750,000 candlepower xenon strobe tube and red polycarbonate lens.

2.1.16 Alarm Horn and Light

2.1.16.1 Alarm horn shall be vibrating type for 120 Volts, 60 Hertz.

2.1.16.2 Alarm light shall be a NEMA 4X flashing strobe unit with red glass globe, for use on a 120 Volts, 60 Hertz power supply.

2.1.17 Photocells

The photocells shall be suitable for power duty with individual fixtures or for pilot duty with contactors as required for proper operation of the equipment furnished. Enclosure shall be NEMA 3R or 4. Contacts shall be rated for 2,000 watts continuous at 120 Volts. The unit shall turn on at 1.5 footcandles and off at 5.5 footcandles.

2.1.18 24-Hour Programmable Timers

2.1.18.1 Unless otherwise specified, time switches shall be of the programmable type capable of being programmed at the intervals as noted on the approved drawings over a 24-hour day. Program tabs shall be easily set by hand without tools to obtain or to change the desired programming schedule. The switching condition shall be maintained when adjacent tabs are set alike.

2.1.18.2 The unit shall be powered by a self-starting, enclosed, 120 Volt, synchronous motor capable of continuous accurate operation. A reserve power, precision wound spring and associated escapement device shall be integrally mounted to maintain time settings during power failures of up to 24 hours.

2.1.18.3 The switch mechanism shall be a self-contained unit rated at not less than 20 Amps, 120 Volts, single pole, double throw and shall be readily replaceable in the field.

2.1.18.4 An omitting device shall be furnished as an integral part of the time switching operation to be skipped for any preselected day or days of the week.

2.2 CONTROL SYSTEM

The manufacturer shall provide a complete and fully functional control system to manually or automatically operate the control system as specified herein and in other applicable sections of these specifications. All manufacturers recommended safety devices shall be furnished to protect operators. All control devices, unless specified otherwise, shall be mounted in the Control Panel.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Mounting Stands

Field mounted disconnects, pushbutton control stations, etc., shall be mounted on 316 stainless steel stands as specified herein or required for proper operation of the equipment furnished. Where clearance requirements for stands may not be maintained, the Engineer may direct equipment to be wall-mounted adjacent to the motor or device, but in no case shall the distance from the motor or device to the control station exceed 3 feet.

END OF SECTION

SECTION 16220

MOTORS

PART 1 GENERAL

1.1 SCOPE OF WORK

All motors shall be furnished as called for in other Sections of these Specifications and shall be in conformance with the requirements of this Section.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The revision in effect at the time of award shall apply. Where reference is made to one of the below standards, the revision in effect at the time of contract award shall apply.

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA Std. 9 Ball Bearing Load Ratings

AFBMA Std. 11 Roller Bearing Load Ratings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 43 IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery

IEEE 85 IEEE Standard Test Procedure for Airborne Sound Measurement on Rotating Electrical Machinery

IEEE 112 IEEE Standard Test Procedures for Polyphase Induction Motors and Generators

NATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS-2003 Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG1 Motors and Generators

UNDERWRITER LABORATORIES (UL)

UL 810 Standards for Capacitors

U.S. DEPARTMENT OF ENERGY (DOE)

DOE CI-1 How to Buy a Premium Energy-Efficient Electric Motor

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Motor Data; Product Data; EA

The Contractor shall submittal motor data for acceptance that includes complete nameplate data and test characteristics in accordance with NEMA Standard MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors" and, in addition, the following for motors typical of the units furnished:

1.3.1.1 Efficiency at 1/2, 3/4, and full load

1.3.1.2 Power factor at 1/2, 3/4, and full load

1.3.1.3 Motor outline, dimensions, and weight

1.3.1.4 Descriptive bulletins, including full description of insulation system

1.3.1.5 Bearing design data

1.3.1.6 Special features (i.e., space heaters, temperature detectors, etc.)

1.3.1.7 Power factor correction capacitor rating and type

1.3.2 Dimension Drawings; Shop Drawings; EA

The motor manufacturer shall submit certified dimension prints showing nameplate data and outline dimensions within three weeks of the date they receive the order.

1.3.3 Equipment Guarantee; Certificates; FIO

All equipment furnished and installed under this Section shall be guaranteed against defects of workmanship, materials, and proper installation for a period of one (1) year from date of acceptance. All such equipment or parts proven defective, due to the above noted causes, shall be replaced in the machines by the Contractor at no expense to the Government.

1.3.4 Equipment Warranty; Certificates; FIO

The Contractor shall provide copies of the equipment warranties for all equipment covered under this Section upon receipt of equipment. The equipment shall be warranted by the manufacturer for a period of one (1) year.

1.4 QUALIFICATIONS

Routine tests shall be performed on representative motors, and shall include the information described on NEMA MG1-12.54 "Report of Test Form for Routine Tests on Induction Motors." Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 Unless otherwise noted, all motors ½ through 100 horsepower shall be rated 230/460 volt, 3 phase, 60 Hertz A.C.; motors 125 horsepower and above shall be rated 460 volt, 3-phase, 60 Hertz; and motors below ½ horsepower shall be rated 115/230 volt, 1 phase, 60 Hertz A.C.

2.1.2 All motors used with variable frequency drives shall be rated for inverter duty and shall be in accordance with NEMA MG1-Revision 1-2004.

2.1.3 All motors shall be built in accordance with current NEMA and IEEE standards. Motors shall be of the type and quality described by this Section and other Divisions of the Specifications, and/or as shown on the approved drawings, fully capable of performing in accordance with manufacturer's nameplate rating, and free from defective material and workmanship.

2.2 RATINGS

2.2.1 All motors shall be sufficient size for the duty to be performed and shall not exceed their full-rated load when the driven equipment is operating at specified capacity and over the operational range. Unless otherwise noted, motors driving pumps, blowers, etc. shall not be overloaded at any head or discharge condition. The motor shall not be required to deliver more than its rated nameplate horsepower, at the 1.0 service factor, under any condition of mechanical or hydraulic loading (i.e., although a 1.15 service factor is required, it may not be used under any condition).

2.2.2 Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where shown on the approved Electrical drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

2.2.3 All motors shall be continuous time rated suitable for operation in a 40 degrees C ambient unless noted otherwise.

2.2.4 Specific motor data such as HP, rpm, etc., is specified under the detailed specification for the equipment with which the motor is supplied.

2.3 NAMEPLATES

The motor manufacturer's nameplates shall be engraved or embossed on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MG1-10.38 or MG1-20.60, as applicable.

2.4 CONDENSATION HEATERS

Condensation heaters, where specified herein or under the detailed mechanical specifications shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 Volt, single phase with wattage as required. The heater wattage and voltage shall be embossed on the motor nameplate.

2.5 WINDING TEMPERATURE DETECTORS

Winding temperature detectors, unless specified otherwise herein shall be a factory installed, embedded, bi-metallic switch type with leads terminating in the main conduit box. This device shall protect the motor against damage from overheating caused by single phasing, overload, high ambient temperature, abnormal voltage, locked rotor, frequent starts, or ventilation failure. The switch shall have normally open contacts. Not less than three detectors shall be furnished with each motor.

2.6 POWER FACTOR CORRECTION CAPACITORS

2.6.1 The operating power factor of the motors shall range from 93 to 95 percent at full load and 95 to 98 percent when partially loaded. The capacitor current shall not exceed the motor no-load magnetizing current.

2.6.2 Capacitors shall be oil insulated or dry type (600 Volt capacitors shall be of the dry type) with three high interrupting capacity current limiting integral fuse protection, blown fuse indicators, and discharge resistor and shall be hermetically sealed in steel enclosures. The insulating medium shall be nonflammable and meet the U. S. Environmental Protection Agency Standards. Covers shall be gasketed, bolt-on type. Capacitors shall be UL listed and NEMA rated and tested. Oil insulated type shall be non-PCB dielectric, biodegradable, and low toxicity.

2.6.3 Units shall be designed to provide power factor correction in applications subject to the effects of harmonics as required for each installation. Where required, units shall consist of power factor correction capacitors as specified above and equipped with series inductors. The units shall be tuned to just below the 5th harmonic frequency on systems with predominately 3 Phase loads. Inductors shall have low flux density and distributed gaps, copper windings, brazed connections, winding varnish impregnated and baked, Class 220 degrees C insulation with 80 degrees C rise.

2.7 THREE PHASE INDUCTION MOTORS

2.7.1 Motors 50 horsepower and larger shall have a 120-V space heater for moisture control.

2.7.2 Unless specifically noted in other Sections of these Specifications, all motors shall have minimum efficiencies as listed below.

Horsepower	NEMA Nominal Efficiency, %
1-2	85.5
3-5	88.5
7-1/2	89.5
10	90.2
15	91.0
20	92.0
25	92.2
30	92.4
40-50	94.0
60-100	94.5
Over 100	95.0

2.8 CONSTRUCTION

2.8.1 General

2.8.1.1 All drip-proof and weather-protected Type I and Type II motors shall have epoxy-encapsulated windings. Totally enclosed motors shall be provided with an upgraded insulation by additional dips and bakes to increase moisture resistance and shall not be encapsulated. Motors for outdoor service shall have vacuum-pressure impregnated (VPI) epoxy insulation for moisture resistance. Two-speed motors shall be of the two-winding type.

2.8.1.2 Squirrel-cage rotors shall be made from high-grade steel laminations adequately fastened together and to the shaft, or shall be cast aluminum or bar-type construction with brazed end rings.

2.8.1.3 All motors shall be of the premium efficiency and high power factor type. All motors shall be the corrosion resistant type conforming to motors designated as "Corro-Duty" by U. S. Motors or equal as approved by the Engineer.

2.8.1.4 Vertical motors shall be hollow or solid shaft as required by the equipment furnished under other Sections of these Specifications.

2.8.1.5 Totally enclosed non-ventilated (TENV) motors shall include the same ratings and accessories as specified for totally enclosed fan cooled (TEFC) motors. Explosion-proof motors shall be underwriter laboratories (UL) listed and factory mutual (FM) approved for Class 1, Division 1 hazardous areas.

2.8.2 Low Voltage, Three Phase Motors

2.8.2.1 Motors shall be of the squirrel-cage induction type. Horizontal, vertical solid shaft, vertical hollow shaft, normal thrust, and high thrust types shall be furnished as specified in other Sections of these Specifications. Motors shall be of the type and quality described by these Specifications, fully capable of performing in accordance with Manufacturer's nameplate rating, and free from defective material and workmanship.

2.8.2.2 Motors shall have normal or high starting torque (as required), low starting current (not to exceed 650 percent full load current), and low slip.

2.8.2.3 Unless otherwise specified, motors shall be totally enclosed fan-cooled construction with a 1.15 service factor at the Class B Temperature-Rise.

2.8.2.4 The output shaft shall be suitable for direct connection or belt drive as required.

2.8.2.5 Motors shall have a Class F non-hygroscopic insulation system but shall be limited to Class B Temperature-Rise, at 1.15 service factor.

2.8.2.6 All motors shall have a final coating of chemical resistant corrosion and fungus protective epoxy fortified enamel finish sprayed over red primer over all interior and exterior surfaces. Stator bore and rotor of all motors shall be epoxy coated.

2.8.2.7 All fittings, bolts, nuts, and screws shall be plated to resist corrosion. Bolts and nuts shall have hex heads.

2.8.2.8 All machine surfaces shall be coated with rust inhibiter for easy disassembly.

2.8.2.9 Conduit box shall be split from top to bottom and shall be capable of being rotated to four 90-degree positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and sealed with a non-wicking, non-hygroscopic insulating material. A frame-mounted pad with drilled and tapped hole, not less than 1/4-inch diameter, shall be provided inside the conduit box for motor frame grounding. All motor conduit boxes shall be provided with the correct number of conduit openings sized as indicated on the approved drawings. Boxes shall be suitably sized for conductor bending and terminations.

2.8.2.10 Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.

2.8.2.11 Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T and larger. Enclosures shall have stainless steel screens. Motors shall be protected for corrosion, fungus, and insects.

2.8.2.12 Fractional Horsepower

2.8.2.12.1 Fractional horsepower motors shall be rigid, welded-steel, designed to maintain accurate alignment of motor components and provide adequate protection. End shields shall be cast iron or heavy fabricated steel. Windings shall be of varnish-insulated wire with slot insulation of polyester film, baked-on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses, and other hazards.

2.8.2.12.2 Motor shaft shall be made from high-grade, cold-rolled shaft steel with drive-shaft extensions carefully machined to standard NEMA dimensions for the particular drive connection.

2.8.2.12.3 For light to moderate loading, bearings shall be quiet all-angle sleeve type with large oil reservoir that prevents leakage and permits motor operation in any position.

2.8.2.12.4 For heavy loading, bearings shall be carefully selected precision ball bearings with extra quality, long-life grease, and large reservoir providing 10 years normal operation without re-lubrication.

2.8.2.13 Integral Horsepower

2.8.2.13.1 Motor frames and end shields shall be cast iron or heavy fabricated steel of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.

2.8.2.13.2 Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibrations.

2.8.2.13.3 The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be ground and polished.

2.8.2.13.4 Rotors shall be made from high-grade steel laminations adequately fastened together, and to the shaft. Rotor squirrel-cage windings may be cast-aluminum or bar-type construction with brazed end rings.

2.8.2.13.5 Motors shall be equipped with vacuum-degassed anti-friction bearings made to AFBMA Standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent lubrication, but facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of lubricant out of the bearing cavity.

2.8.2.13.6 Bearings of high thrust motors will be locked for momentary up thrust of 30 percent down thrust. All bearings shall have a minimum B10 life rating of 5 years in accordance with AFBMA life and thrust values.

2.8.2.13.7 Vertical hollow-shaft motors will have nonreverse ratchets to prevent backspin. Non-reverse ratchets shall be suitable for duty with variable frequency drives.

2.8.3 Low Voltage, Single Phase Motors

2.8.3.1 Single-phase motors shall be split-phase and capacitor-start induction types rated for continuous horsepower at the rpm indicated on the approved drawings or as required by the Specifications. Motors shall be rated 115/230 Volts, 60 Hertz, single phase, open drip proof, or totally enclosed fan cooled as indicated on the approved drawings or as required by the Specifications, with temperature rise in accordance with NEMA Standards for Class B insulation.

2.8.3.2 Totally enclosed fan cooled motors shall be designed for severe-duty.

2.8.3.3 Motors shall have corrosion and fungus protective finish on internal and external surfaces. All fittings shall have corrosion protective plating.

2.8.3.4 Mechanical characteristics shall be the same as specified for polyphase fractional horsepower motors.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Motor Connections: All motors shall be connected to the conduit system by means of a short section 18-inch minimum of liquid tight conduit unless otherwise indicated. For all motor connections of No. 4 AWG or larger wire size, the Contractor shall install a grounding conductor in the conduit and terminate at main conduit box and at the motor control center or variable frequency drive with approved ground lugs and clamps.

3.1.2 Low Voltage: For wire sizes No. 8 AWG and larger, long barrel tin-plated copper compression (hydraulically pressed) type connections shall be installed on the branch circuit wires and the motor leads. Bolted connections shall utilize products that are rated for vibration applications (bolt, nut, and spring washer). All connections shall be insulated with heavy-duty heat shrinkable material (Raychem Corp., or equal as approved by the Engineer).

3.2 TESTS AND CHECKS

3.2.1 The following tests shall be performed on all motors after installation but before putting motors into service.

3.2.1.1 The Contractor shall megger (1,000 volts DC) each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the Engineer and shall not energize the motor. The following table gives minimum acceptable insulation resistance in megohms at various temperatures and for various voltages with readings being taken after one (1) minute of megger test run.

Winding Temperature		Voltage		
°F	°C	115 V	230 V	460V
37	3.9	60	108	210
50	10	32	60	120
68	20	13	26	50
86	30	5.6	11	21
104	45	2.4	4.5	8.8
122	50	1	2	3.7
140	60	0.50	0.85	1.6

3.2.1.2 The Contractor shall check all motors for correct clearances and alignment and for correct lubrication, and shall lubricate if required in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections if necessary. The correction for wrong rotational direction shall be made at the motor.

3.2.1.3 All tests shall meet the requirements of, but not be limited to, IEEE 43, 85, and 112. Efficiency tests for IEEE 112 shall include Method B.

3.2.1.4 The Contractor shall provide to the Engineer a typed list of all motors 1 HP and larger listing the no load motor current and voltage and the full load current and voltage. Any phase current imbalance greater than 10 percent shall be reported to the Engineer.

3.2.2 The following test shall apply to the medium voltage motors:

All motors shall be given the standard short commercial test prior to shipment. This shall consist of no load current, check current balance, winding resistance, air gap measurement, high potential tests, and bearing inspection. Six (6) copies of the certified short commercial test shall be submitted to the Engineer prior to shipment.

3.2.3 Field testing and commissioning shall be done in accordance with the latest revision NETA Standard ATS-2003.

END OF SECTION

SECTION 16261

VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish and install all variable frequency drive (VFD) systems as specified herein and in SECTION 13300 - GROUNDWATER TREATMENT SYSTEM.

1.1.2 This Section provides the requirements for variable frequency drive systems typically employed in a facility, however, not all components specified in this Section are necessarily utilized on this project.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Where reference is made to one of the below standards, the revision in effect at the time of contract award shall apply.

<u>INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)</u>

IEEE C62.41	Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

<u>NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)</u>

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	Industrial Control and Systems: General Requirements
NEMA ICS 3.1	Industrial Control and Systems: Handling, Storage and Installation Guide for AC General-Purpose Medium Voltage Contactors and Class E Controllers, 50 and 60 Hertz
NEMA ICS 6	Industrial Control and Systems: Enclosures
NEMA ICS 7	Industrial Control and Systems: Adjustable-Speed Drives

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 508C	Power Conversion Equipment

1.3.2 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Shop Drawings; Shop Drawings; EA

Submit schematic diagrams, interconnecting diagrams, and installation drawings for government approval prior to equipment construction or integration. Modifications to original drawings made during installation shall be immediately recorded for inclusion into the as-built drawings. As-built drawings are submitted under SECTION 01550 – SURVEYING.

1.3.2 Equipment Data; Product Data; EA

Submittal of equipment data for acceptance shall include complete data and test characteristics for variable frequency drives, wires and cables, equipment schedule, and data indicating compatibility with motors being driven.

1.3.3 Test Reports; Test Reports; FIO

Provide copies of test reports specified in Paragraph 3.2 including VFD tests, performance verification tests, and endurance tests.

1.3.4 Manufacturer's Instructions; Manufacturer's Instructions; FIO

Provide manufacturer's instructions for the equipment specified herein.

1.3.5 Manufacturer's Field Reports; Manufacturer's Field Reports; FIO

Submit copies of the VFD Factory Test Plan and factory test results in accordance with Paragraph 2.5.

1.3.6 Equipment Warranty; Certificates; FIO

The Contractor shall provide copies of equipment warranties for all equipment covered under this Section upon receipt of equipment. The equipment shall be warranted by the manufacturer for a period of one year.

1.3.7 The Contractor shall submit operations and maintenance data under SECTION 01850 - FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND STARTUP TRAINING. The O&M manual shall include service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Provide instructions on how to modify program settings, modify the control program, adjust drives, trouble-shooting, configuration, process tuning and system calibration.

1.4 SYSTEM DESCRIPTION

1.4.1 Performance Requirements

1.4.1.1 Electromagnetic Interference Suppression

Computing devices, as defined by 47 CFR 15, MIL-STD-461 rules and regulations, shall be certified to comply with the requirements for class A computing devices and labeled as set forth in part 15.

1.4.1.2 Electromechanical and Electrical Components

Electrical and electromechanical components of the VFDs shall not cause electromagnetic interference to adjacent electrical or electromechanical equipment while in operation.

1.4.2 Electrical Requirements

1.4.2.1 Power Line Surge Protection

Control panel shall have surge protection, included within the panel to protect the unit from damaging transient voltage surges. Surge arrestor shall be mounted near the incoming power source and properly wired to all three phases and ground. Fuses shall not be used for surge protection. VFDs shall comply with IEEE C62.41 and IEEE Standard 519.

1.4.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

1.4.2.2.1 A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

1.4.2.2.2 An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.5 QUALITY ASSURANCE

1.5.1 Schematic Diagrams

Show circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify proper operation of the functional assemblies.

1.5.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.5.3 Installation Drawings

Show power and instrumentation plan with location of VFDs and motors. Indicate ventilation requirements, adequate clearances, site environmental requirements (corrosive, wet, etc.) and cable routes.

1.5.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule shall provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule shall include the total quantity of each item of equipment supplied. For complete assemblies, such as VFD's, provide the serial numbers of each assembly, and a sub-schedule of components within the assembly. Provide recommended spare parts listing for each assembly or component.

1.5.5 Installation instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.5.6 Factory Test Results

Document test results and submit to government within 7 working days after completion of test.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 MAINTENANCE

1.7.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES (VFD)

Provide frequency drive to control the speed of induction motor(s). The VFD shall include the following minimum functions, features and ratings:

2.1.1 Input circuit breaker per UL 489 with a minimum of 65,000 amps symmetrical interrupting capacity and door interlocked external operator.

2.1.2 A converter stage per UL 508C shall change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter shall utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter shall be insensitive to three phase rotation of the ac line and shall not cause displacement power factor of less than .95 lagging under any speed and load condition.

2.1.3 An inverter stage shall change fixed dc voltage to variable frequency, variable voltage, ac for application to a standard NEMA design B squirrel cage motor. The inverter shall be switched in a manner to produce a sine coded pulse width modulated (PWM) output waveform.

2.1.4 The VFD shall be capable of supplying 150 percent of rated full load current for one minute at maximum ambient temperature.

2.1.5 The VFD shall be designed to operate from a 208 volt, +/- 10 percent, three phase, 60 Hz supply, and control motors with a corresponding voltage rating.

2.1.6 Acceleration and deceleration time shall be independently adjustable from one second to 60 seconds.

2.1.7 Adjustable full-time current limiting shall limit the current to a preset value which shall not exceed 150 percent of the controller rated current. The current limiting action shall maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override shall allow starting current to reach 175 percent of controller rated current to maximum starting torque.

2.1.8 The controllers shall be capable of producing an output frequency over the range of 3 Hz to 60 Hz (20 to one speed range), without low speed cogging. Over frequency protection shall be included such that a failure in the controller electronic circuitry shall not cause frequency to exceed 110 percent of the maximum controller output frequency selected.

2.1.9 Minimum and maximum output frequency shall be adjustable over the following ranges:

2.1.9.1 Minimum frequency 3 Hz to 50 percent of maximum selected frequency.

2.1.9.2 Maximum frequency 30 Hz to 60 Hz.

2.1.10 The controller efficiency at any speed shall not be less than 96 percent.

2.1.11 The controllers shall be capable of being restarted into a motor coasting in the forward direction without tripping.

2.1.12 Protection of power semiconductor components shall be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions shall not result in component failure or the need for fuse replacement:

2.1.12.1 Short circuit at controller output

2.1.12.2 Ground fault at controller output

2.1.12.3 Open circuit at controller output

2.1.12.4 Input undervoltage

2.1.12.5 Input overvoltage

2.1.12.6 Loss of input phase

2.1.12.7 AC line switching transients

2.1.12.8 Instantaneous overload

2.1.12.9 Sustained overload exceeding 115 percent of controller rated current

2.1.12.10 Over temperature

2.1.12.11 Phase reversal

2.1.13 Solid state motor overload protection shall be included such that current exceeding an adjustable threshold shall activate a 60 second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down.

2.1.14 A slip compensation circuit shall be included which will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA B motors to within +/- 0.5 percent of maximum speed without the necessity of a tachometer generator.

2.1.15 The VFD shall be factory set for manual restart after the first protective circuit trip for malfunction (overcurrent, undervoltage, overvoltage or overtemperature) or an interruption of power. The VFD shall be capable of being set for automatic restart after a selected time delay. If the drive faults again within a specified time period (adjustable 0-60 seconds), a manual restart will be required.

2.1.16 The VFD shall include external fault reset capability. All the necessary logic to accept an external fault reset contact shall be included.

2.1.17 Provide critical speed lockout circuitry to prevent operating at frequencies with critical harmonics that cause resonant vibrations. The VFD shall have a minimum of three user selectable bandwidths.

2.1.18 Provide the following operator control and monitoring devices mounted on the front panel of the VFD:

2.1.18.1 Manual speed potentiometer

2.1.18.2 Hand-Off-Auto (HOA) switch

2.1.18.3 Power on light

2.1.18.4 Drive run power light

2.1.18.5 Local display

2.1.19 Provide properly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of VFD failure. Mechanical and electrical interlocks shall be installed between the by-pass and isolation contactors. Provide a selector switch and transfer delay timer.

2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, NEMA ICS 6.

2.3 WIRES AND CABLES

All wires and cables shall conform to NEMA 250, NEMA ICS 7, NFPA 70.

2.4 NAMEPLATES

Nameplates external to NEMA enclosures shall conform with the requirements of SECTION 16000 - ELECTRICAL - GENERAL PROVISIONS. Nameplates internal to enclosures shall be manufacturer's standard, with the exception that they must be permanent.

2.5 SOURCE QUALITY CONTROL

2.5.1 VFD Factory Test Plan

To ensure quality, each VFD shall be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test plans and test reports.

PART 3 EXECUTION

3.1 INSTALLATION

Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the drive manufacturer shall supervise the installation of all equipment, and wiring.

3.2 FIELD QUALITY CONTROL

Specified products shall be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Contractor shall conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Contractor shall submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.2.1 VFD Test

A proposed test plan shall be submitted to the Engineer at least 28 calendar days prior to proposed testing for approval. The tests shall conform to NEMA ICS 1, NEMA ICS 7, and all manufacturer's safety regulations. The Government reserves the right to witness all tests and review any documentation. The contractor shall inform the Government at least 14 working days prior to the dates of testing. Contractor shall provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. All training aids, texts, and expendable support material for a self-sufficient presentation shall be provided, the amount of which to be determined by the Engineer.

3.2.2 Performance Verification Tests

"Performance Verification Test" plan shall provide the step by step procedure required to establish formal verification of the performance of the VFD. Compliance with the specification requirements shall be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. The contractor shall inform the Government 14 calendar days prior to the date the test is to be conducted.

3.2.3 Endurance Test

Immediately upon completion of the performance verification test, the endurance test shall commence. The system shall be operated at varying rates for not less than 192 consecutive hours, at an average effectiveness level of .9998, to demonstrate proper functioning of the complete PCS. Continue the test on a day-to-day basis until performance standard is met. During the endurance test, the contractor shall not be allowed in the building. The system shall respond as designed.

END OF SECTION

SECTION 16375

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to provide an underground electrical distribution system for the groundwater extraction and treatment system. The work shall be coordinated with the local utility provider and performed according to local utility provider requirements.

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions:

1.2.2.1 Frequency 60 Hz

1.2.2.2 Seismic Zone 2A

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the below standards, the revision in effect at the time of contract award shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.10	Electromechanical Watthour Meters
ANSI C12.11	Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL
ANSI C12.4	Mechanical Demand Registers
ANSI C29.1	Electrical Power Insulators- Test Methods
ANSI C37.46	Power Fuses and Fuse Disconnecting Switches
ANSI C57.12.21	Requirements of Pad-Mounted, Compartmental-Type, Self Cooled, Single-Phase Distribution Transformers with High Voltage Bushings

	(High-Voltage, 34 500 GrdY/19 920 Volts and Below; Low-Voltage, 240/120; 167 kVA and Smaller
ANSI C57.12.26	Pad-Mounted Compartmental-Type, Self Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 GrdY/19 920 Volts and Below; 2500 kVA and Smaller
ANSI C80.1	Rigid Steel Conduit - Zinc Coated
ANSI C119.1	Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI O5.1	Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	Operating Salt Spray (Fog) Testing Apparatus
ASTM D 923	Sampling Electrical Insulating Liquids
ASTM D 1654	Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 4059	Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM F 883	Padlocks

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	National Electrical Safety Code
IEEE C37.35	Guide for the Application, Installation, Operation, and Maintenance of High-Voltage Air Disconnecting and Load Interrupter Switches
IEEE C57.12.00	Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	Instrument Transformers
IEEE C57.98	Guide for Transformer Impulse Tests
IEEE C62.1	Surge Arresters for AC Power Circuits
IEEE C62.11	Metal-Oxide Surge Arresters for AC Power Circuits

IEEE C62.2	Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE Std 48	Standard Test Procedures and Requirements for Alternative-Current Cable Terminations 2.5 kV Through 765 kV
IEEE Std 100	IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 404	Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500000 V
IEEE Std 590	IEEE Cable Plowing Guide
IEEE Std 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1	Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies
NEMA LA 1	Surge Arresters
NEMA TC 5	Corrugated Polyolefin Coilable Plastic Utilities Duct
NEMA TC 7	Smooth-Wall Coilable Polyethylene Electrical Plastic Duct
NEMA WC 7	Cross-Linked-Thermosetting-Polyethylene- Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6	Rigid Metal Conduit
UL 467	Grounding and Bonding Equipment
UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	Wire Connectors for Use with Aluminum Conductors
UL 514A	Metallic Outlet Boxes

UL 651	Schedule 40 and 80 Rigid PVC Conduit
UL 854	Service-Entrance Cables
UL 1242	Intermediate Metal Conduit

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-621	Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

1.4 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.4.1 Manufacturer's Catalog Data; Product Data; EA

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the Contract Documents.

1.4.2 Material, Equipment, and Fixture Lists; Product Data; EA

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

1.4.3 Electrical Distribution System Drawings; Shop Drawings; EA

1.4.3.1 Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the Contract Drawings. If departures from the Contract Drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

1.4.3.2 Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Engineer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

1.4.3.2.1 Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

1.4.3.2.2 Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

1.4.3.2.3 Detail drawings shall as a minimum depict the installation of the following items:

1.4.3.2.3.1 Medium-voltage cables and accessories.

1.4.3.2.3.2 Transformers.

1.4.3.2.3.3 Surge arresters.

1.4.4 Factory Test; Test Reports; FIO

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in Paragraph 1.3 – References. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 calendar days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in Paragraph 3.8 – Field Testing shall be included.

1.4.5 Field Testing Plan; Test Reports; EA

A proposed field test plan, 30 calendar days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

1.4.6 Test Reports; Test Reports; EA

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

1.4.6.1 A list of equipment used, with calibration certifications.

1.4.6.2 A copy of measurements taken.

1.4.6.3 The dates of testing.

1.4.6.4 The equipment and values to be verified.

1.4.6.5 The condition specified for the test.

1.4.6.6 The test results, signed and dated.

1.4.6.7 A description of adjustments made.

1.4.7 Materials and Equipment Certificates; Certificates; EA

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

1.4.8 The Contractor shall submit operations and maintenance data under SECTION 01850 - FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND STARTUP TRAINING. The O&M manual shall include assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. The manual shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide that lists possible operational problems and corrective action to be taken.

1.4.9 Electrical As-Built Drawings shall be submitted under SECTION 01550 - SURVEYING.

1.5 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to contract award. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl (PCB). If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 50ppm PCB content in accordance with Paragraph 2.13 - Liquid Dielectrics. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB-insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153 and ASTM A 123.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Conductor Material

Underground cables shall be of soft drawn copper conductor material.

2.4.2 Medium-Voltage Cables

2.4.2.1 General

Medium voltage cables shall conform to the requirements of NEMA WC 7 for cables utilizing cross-linked thermosetting polyethylene (XLP) insulation and NEMA WC 8 for cables utilizing ethylene-propylene-rubber (EPR) insulation. Cables shall be in accordance with the requirements of NFPA 70. If metallic armored cables are specified, then they shall be three-conductor, multiple-conductor cable with interlocked-metal tape armor and thermoplastic jackets as required for underground installations.

2.4.2.2 Insulation

Cables shall utilize XLP insulation. Cables shall be provided with 133 percent insulation level except that 28 kV and 35 kV rated cable insulation thicknesses shall be in accordance with AEIC CS5 or AEIC CS6 as applicable.

2.4.2.3 Jackets

Cables shall be provided with a nonmetallic jacket. Concentric neutral cables for direct buried applications shall have a moisture-resistant, nonmetallic jacket rated for direct burial.

2.4.2.4 Neutrals

Neutral conductors of grounded neutral systems except for concentric neutral cables shall be of the same insulation material as phase conductors, except that a 600-volt insulation rating is acceptable. Cables employing a concentric neutral shall have full concentric neutral with an insulating jacket over the concentric neutral.

2.4.2.5 Shielding

Cables rated for above 2 kV shall have both conductor and insulation shielding for each phase, except insulation shielding is not required for 5 kV armored or metallic-sheathed cable.

2.4.2.6 Ratings

Medium-voltage cables shall be rated for a circuit voltage of 15 kV as indicated.

2.4.3 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70. Cables shall utilize XLP insulation and shall conform to the requirements of NEMA WC 7 or ethylene-propylene-rubber (EPR) insulation and shall conform to the requirements of NEMA WC 8.

2.4.3.1 Direct Buried

Service entrance cables shall conform to UL 854 for Type USE service entrance cable. Other direct buried cable applications shall be single-conductor cable identified for such use and conforming to NEMA WC 7 or NEMA WC 8.

2.4.3.2 Cables in Duct

Cables shall be single-conductor cable, Type RHW, THW, THWN, TW, USE, or XHHW in accordance with NFPA 70. Cables in factory-installed, coilable-plastic-duct assemblies shall conform to NEMA TC 5 or NEMA TC 7.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application. Duct lines shall be non-encased direct-burial, thick-wall type.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Direct Burial

UL 651 Schedule 80.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cast the words "ELECTRIC" and "TELEPHONE" in the top face of power and telephone manhole covers, respectively. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable. Provide cast iron frames and covers for manholes conforming to FS RR-F-621. Provide steel frames and covers of rolled steel floor plate for handholes.

2.8 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

2.8.1 Transformers, substations, and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 5 kV between phases for 133 percent insulation level.

2.8.2 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.26 and shall be of the radial type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

2.8.2.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, drawout, dry-well-mounted, current-limiting fuses, medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. Fuses shall comply with the requirements of Paragraph 2.9 - Metering and Protective Devices. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stenciled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on the same bushing as the primary cable by means of a loadbreak, feed-through bushing insert.

2.8.2.2 Load-Break Switch

Radial-feed oil-immersed type rated in accordance with IEEE C37.35. Locate the switch handle in the high-voltage compartment.

2.8.2.3 Transformer Tank Sections

Transformers shall comply with IEEE C57.12.00, ANSI C57.12.21, and ANSI C57.12.26 and shall be of the mineral oil-insulated type with high molecular-weight hydrocarbon liquid. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity	Actual load + 25%
Impedance	Based on standard transformer size selected
Temperature Rise	65 degrees C
* High-voltage winding	As required by Utility Company
High-voltage winding connections	As required by Utility Company
Low-voltage winding	480/277 volts
Low-voltage winding connections	Wye

* ***Contractor shall verify available service from local utility***

2.8.2.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

2.8.2.5 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.9 METERING AND PROTECTIVE DEVICES

2.9.1 Fuses, Medium-Voltage, Including Current-Limiting

2.9.1.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.9.1.2 Ratings

Current-limiting power fuses shall have ratings in accordance with ANSI C37.46 .

2.9.1.3 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to ANSI C37.46.

2.9.2 Instrument Transformers

2.9.2.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on the approved drawings.

2.9.2.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall not be less than 2.0. Other thermal and mechanical ratings of current transformers and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accident open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.9.2.3 Current Transformers for KWh and Demand Metering (Low-Voltage)

Current transformers shall conform to IEEE C57.13. Provide current transformers with a metering accuracy Class of 0.3, with a minimum RF of 2.0 at 30 degrees C, with 600-Volt insulations, and 10 kV BIL.

2.9.3 Watthour Meters

Watthour meters shall comply with ANSI C12.10, except that numbered terminal wiring sequence and case size may be the manufacturer's standard. Watthour meters shall be of the drawout switchboard type having a 15 minute, cumulative form, demand register meeting ANSI C12.4 and provided with not less than 2-1/2 stators. Watthour demand meters shall have factory-installed electronic pulse initiators meeting the requirements of ANSI C12.10. Pulse initiators shall be solid-state devices incorporating light-emitting diodes, phototransistors, and power transistors, except that mercury-wetted output contacts are acceptable. Initiators shall be totally contained within watthour demand meter enclosures. They shall be capable of operating at speeds up to 500 pulses per minute with no false pulses, and they shall be factory calibrated with no field adjustments being required. Initiators shall be calibrated for a pulse rate output of 1 pulse per 1/4 disc revolution of the associated meter and shall be compatible with the indicated equipment.

2.10 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be distribution class, rated as shown. Arresters for use at elevations in excess of 6,000 feet above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the metal-oxide varistor type.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 10 feet in length. Sectional type rods may be used.

2.11.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.12 PADLOCKS

Padlocks shall conform to ASTM F 883, Type EPC.

2.13 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 50 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Engineer. Equipment with test results indicating PCB level exceeding 50 ppm shall be replaced.

2.14 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these Specifications. The Engineer shall be notified at least 10 days before the equipment is ready for testing. The Engineer reserves the right to witness the tests.

2.14.1 Transformers: Manufacturer's standard design tests in accordance with IEEE C57.12.00.

2.14.2 Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

2.14.3 Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE C57.13.

2.14.4 Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

2.14.5 Electrical Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Installation shall be in compliance with local utility provider requirements. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of SECTION 02300 - EARTHWORK. Concrete work shall have minimum 3,000 psi compressive strength and conform to the requirements of DIVISION 3 - CONCRETE.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Engineer of any discrepancy before performing any work.

3.2 CABLE AND BUSWAY INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. The Contractor shall then prepare a checklist of significant requirements that shall be submitted along with the manufacturers instructions in accordance with Paragraph 1.4 - Submittals.

3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or equal as approved by the Engineer, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information: cable type, conductor size, circuit number, circuit voltage, cable destination, and phase identification.

3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manila rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

3.2.2 Duct Line

Low-voltage cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.3 Direct-Burial

Low-voltage cables shall be buried directly in the earth where indicated. Minimum cover from the top of a cable to finished grade shall not be less than 30 inches.

3.2.3.1 Trenching

Trenches for direct-burial cables shall be excavated to depths required to provide the minimum necessary cable cover. Bottoms of trenches shall be smooth and free of stones and sharp objects. Where bottoms of trenches comprise materials other than sand, a 6 inch layer of fill shall be laid first and compacted to approximate densities of surrounding firm soil.

3.2.3.2 Plowing

Chute plowing, in accordance with IEEE Std. 590, is permitted. Only coilable conduit with pre-installed conductors shall be plowed into rocky soil. Plowing depths shall be below the frost line of 30 inches and in accordance with NFPA 70 requirements.

3.2.3.3 Cable Burial

Cables shall be unreeled along the sides of or in trenches and carefully placed on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position will not be permitted, except as required to pull cables through conduits under paving or railroad tracks. Where cables cross, a separation of at least 3 inches shall be provided, unless each cable circuit is protected by a nonmetallic conduit sleeve at the crossing. Where single-conductor cable is installed, all 3 phases and the neutral shall be installed in the same sleeve. Bend radius of any cable shall be not less than 8 times the diameter of the cable. In no case shall cables be left under longitudinal tension. Machine compaction shall not be used within 6 inches of the cable.

3.2.3.4 Other Requirements

Where direct-burial cables cross under roads or other paving exceeding 5 feet in width, such cables shall be installed in concrete-encased ducts. Where direct-burial cables cross under railroad tracks, such cables shall be installed in reinforced concrete-encased ducts. Ducts shall extend at least 1 foot beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables shall be centered in duct entrances, and a waterproof nonhardening mastic compound shall be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Damage to conduit coatings shall be prevented by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase shall be restored to their original condition.

3.2.3.5 Low-Voltage Cable Splices

Cable joints or splices in direct-burial cables are not permitted in runs of 1,000 feet or less, nor at intervals of less than 1,000 feet in longer runs, except as required for taps. Locations of cable joints or splices in shorter intervals, where required to avoid obstructions or damage to cables, shall be approved. Cable joints or splices in direct burial installations shall be installed in aboveground junction boxes or in cast metal splice boxes suitable for direct burial use. Cable joints or splices in duct banks shall be made only in manholes, handholes, or pullboxes.

3.2.3.6 Cable Markers

Markers shall be located near the ends of cable runs, at each cable joint or splice, at approximately every 500 feet along cable runs, and at changes in direction of cable runs. In addition to markers, a 5 mil, brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers, or other approved dig-in warning indication, shall be placed approximately 12 inches below finished grade levels of trenches.

3.3 DUCT LINES

3.3.1 Requirements

Numbers and sizes of ducts shall be as indicated on the approved drawings. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3-inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.3.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.3.3 Nonencased Direct-Burial

Top of duct lines shall be below a depth of 30 inches and shall be installed with a minimum of 3 inches of earth around each duct, except that between adjacent electric power and communication ducts, 12 inches of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 3-inch layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 6 inches. The first 6 inch layer of backfill cover shall be fill compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 3- to 6-inch layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.3.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.3.4.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.3.5 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

3.4 MANHOLES, HANDHOLES, AND PULLBOXES

3.4.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Engineer before construction of the manhole is started. Manholes shall be the type noted on the Contract Drawings and shall be constructed in accordance with the applicable details as indicated. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the Contract Drawings or specified herein. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a Portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.4.2 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 1/2 inch above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.4.3 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.5 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose. Three-phase transformers shall be installed with 1-2-3 phase sequence.

3.5.1 Concrete Pads

3.5.1.1 Construction

Concrete pads for pad-mounted electrical equipment shall be poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 10 inches above finished floor and sloped to drain. Edges of concrete pads shall have 1-inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.5.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3,000 psi compressive strength and conform to the requirements of DIVISION 3 - CONCRETE. Concrete pad reinforcement shall be in accordance with SECTION 03200 - CONCRETE REINFORCEMENT.

3.5.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.5.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed as directed by the Engineer. Padlocks shall comply with ASTM F 883, Type EPC.

3.6 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as required. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized steel pipe straps spaced not more than 10 feet apart and with 1 strap not more than 12 inches from any bend or termination. Cable guards shall be secured to poles in accordance with the manufacturer's published procedures. Conduits shall be equipped with bushings to protect cables and minimize water entry. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the conduit or guard.

3.7 CONNECTIONS TO BUILDINGS

Grounding electrodes shall be installed as shown on the approved drawings and as follows:

3.7.1 Driven Rod Electrodes

Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.

3.7.2 Ground Ring

A ground ring shall be installed around buildings consisting of bare copper conductors installed 24 inches, plus or minus 3 inches, below finished top of soil grade. Ground ring conductors shall be No. 2 AWG, minimum.

3.7.3 Additional Electrodes

When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors to achieve the specified ground resistance. The additional electrodes will be 10-foot rods spaced a minimum of 20 feet apart. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Engineer shall be notified immediately.

3.7.4 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.7.5 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.7.6 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.7.7 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.7.8 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the approved drawings or required by these Specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as shown on the Contract Drawings. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 2 feet.

3.8 FIELD TESTING

3.8.1 General

Field testing shall be performed in the presence of the Engineer. The Contractor shall notify the Engineer seven days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Engineer. The

Contractor shall maintain a written record of all tests that includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.8.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment that are damaged due to improper test procedures or handling.

3.8.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

3.8.3.1 Single Rod Electrode - 25 ohms.

3.8.3.2 Ground Ring - 10 ohms.

3.8.4 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.8.5 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.8.6 Liquid-Filled Transformer Tests

The following field tests shall be performed on liquid-filled transformers 200 kVA and above. Pass-Fail criteria shall be in accordance with transformer manufacturer's specifications.

3.8.6.1 Insulation resistance test phase-to-ground.

3.8.6.2 Turns ratio test.

3.8.6.3 Correct phase sequence.

3.8.6.4 Correct operation of tap changer.

3.8.7 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

3.8.7.1 Pad-Mounted Transformers

3.8.8 Operating Tests

After the installation is completed, and at such times as the Engineer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with Paragraph 1.4 - Submittals.

3.9 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

END OF SECTION

SECTION 16402

ELECTRICAL WORK, INTERIOR

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to provide interior electrical work in the pre-engineered metal building. The installation shall conform to the requirements of NFPA 70, NFPA 70E and NFPA 101, unless more stringent requirements are indicated herein or shown.

1.1.2 Coordination

The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the approved drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate electrical work with the HVAC and approved electrical drawings and specifications and provide power related wiring.

1.1.3 Special Environments

1.1.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.1.3.2 Hazardous Locations

Wiring in hazardous locations shall conform to NFPA 70 for Class and division. All equipment, material and installation in areas designated as Hazardous shall comply with the National Electrical Code Articles 500, 501, 502, 503 and 504.

1.1.3.3 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70 unless more stringent requirements are indicated in this specification or on the Contract Drawings.

1.1.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to contract award.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the below standards, the revision in effect at the time of contract award shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C39.1	Requirements for Electrical Analog Indicating Instruments
ANSI C82.4	Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	Hard-Drawn Copper Wire
ASTM B 8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	Laminated Thermosetting Materials

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 18	Industrial, Scientific, and Medical Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE ANSI/IEEE C57.13	Instrument Transformers
IEEE C62.41	Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	Molded Case Circuit Breakers and Molded Case Switches
NEMA FU 1	Low Voltage Cartridge Fuses
NEMA ICS 1	Industrial Control and Systems
NEMA ICS 2	Industrial Control and Systems Controllers, Contactors, Overload Relays Rated Not More Than 2,000 Volts AC or 750 DC
NEMA ICS 3	Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	Industrial Control and Systems Enclosures

NEMA LE 4	Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	Motors and Generators
NEMA MG 10	Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA PB 1	Panelboards
NEMA PE 5	Utility Type Battery Chargers
NEMA ST 20	Dry-Type Transformers for General Applications
NEMA WD 1	General Requirements for Wiring Devices
NEMA WD 6	Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace
NFPA 101	Safety to Life from Fire in Buildings and Structures

UNDERWRITERS LABORATORIES (UL)

UL-03	Electrical Construction Materials Directory
UL 1	Flexible Metal Conduit
UL 6	Rigid Metal Conduit
UL 13	Power-Limited Circuit Cables
UL 20	General-Use Snap Switches
UL 50	Enclosures for Electrical Equipment
UL 67	Panelboards
UL 83	Thermoplastic-Insulated Wires and Cables
UL 98	Enclosed and Dead-Front Switches
UL 198B	Class H Fuses
UL 198C	High-Interrupting-Capacity Fuses, Current-Limiting Types

UL 198D	Class K Fuses
UL 198E	Class R Fuses
UL 198G	Fuses for Supplementary Overcurrent Protection
UL 198H	Class T Fuses
UL 198L	D-C Fuses for Industrial Use
UL 360	Liquid-Tight Flexible Steel Conduit
UL 467	Grounding and Bonding Equipment
UL 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	Splicing Wire Connectors
UL 486E	Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 506	Specialty Transformers
UL 508	Industrial Control Equipment
UL 510	Insulating Tape
UL 512	Fuseholders
UL 514A	Metallic Outlet Boxes
UL 514B	Fittings for Conduit and Outlet Boxes
UL 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 674	Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 817	Cord Sets and Power-Supply Cords
UL 845	Motor Control Centers
UL 854	Service-Entrance Cables
UL 869A	Reference Standard for Service Equipment

UL 877	Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 924	Emergency Lighting and Power Equipment
UL 935	Fluorescent-Lamp Ballasts
UL 943	Ground-Fault Circuit Interrupters
UL 1004	Electric Motors
UL 1029	High-Intensity-Discharge Lamp Ballasts
UL 1277	Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
UL 1449	Transient Voltage Surge Suppressors
UL 1479	Fire Tests of Through-Penetration Firestops
UL 1570	Fluorescent Lighting Fixtures
UL 1572	High Intensity Discharge Lighting Fixtures
UL 1581	Electrical Wire, Cables, and Flexible Cords
UL 1660	Liquid-Tight Flexible Nonmetallic Conduit

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Manufacturer's Catalog; Product Data; EA

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

1.3.2 Material, Equipment, and Fixture Lists; Product Data; EA

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

1.3.3 Installation Procedures; Product Data; EA

Installation procedures for rotating equipment, transformers, switchgear, battery systems, voltage regulators, and grounding resistors. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

1.3.4 Interior Electrical Equipment Drawings; Shop Drawings; EA

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Engineer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

1.3.4.1 Transformers

1.3.4.2 Motors and rotating machinery

1.3.4.3 Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.

1.3.4.4 Sway bracing for suspended luminaries

1.3.4.5 Electrical construction drawings.

1.3.5 Structural drawings; Shop Drawings; EA

Drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

1.3.6 Electrical drawings; Shop Drawings; EA

Drawings, including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

1.3.7 Onsite Test; Test Reports; EA

A detailed description of the Contractor's proposed procedures for onsite tests.

1.3.8 Factory Test Reports; Test Reports; EA

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

1.3.8.1 A list of equipment used, with calibration certifications

1.3.8.2 A copy of measurements taken

1.3.8.3 The dates of testing

1.3.8.4 The equipment and values to be verified

1.3.8.5 The conditions specified for the test

1.3.8.6 The test results, signed and dated

1.3.8.7 A description of adjustments made

1.3.9 Field Test Plan; Test Reports; EA

A detailed description of the Contractor's proposed procedures for onsite test submitted 30 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

1.3.10 Field Test Reports; Test Reports; EA

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

1.3.10.1 A list of equipment used, with calibration certifications

1.3.10.2 A copy of measurements taken

1.3.10.3 The dates of testing

1.3.10.4 The equipment and values to be verified

1.3.10.5 The conditions specified for the test

1.3.10.6 The test results, signed and dated

1.3.10.7 A description of adjustments made

1.3.10.8 Final position of controls and device settings

1.3.11 Materials and Equipment Certificates; Certificates; EA

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Engineer. Items that are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data. For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.3.12 Electrical As-Built Drawings shall be submitted under SECTION 01550 - SURVEYING.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 CABLES AND WIRES

Wires and cables shall be annealed, 98 percent conductivity, soft drawn copper. All conductors shall be stranded, except that lighting and receptacle wiring may be solid. Except for control, signal, and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.

2.1.1 Multi-conductor control and power cables shall have stranded conductors with type nylon conductor covering, and an overall PVC jacket covering the individual wires. Cable shall be TC rated meeting UL 1277 Standard. Cable shall be flame resistant, non-propagating and suitable for direct burial in earth. Power and control cables shall be furnished with a green ground conductor. Power cables shall be furnished with a white neutral conductor where required to serve phase to neutral loads.

2.1.2 Wire for process instrumentation signals (i.e., 1-5 VDC, 4-20 mA), R.T.D, potentiometer and similar signals shall be:

2.1.2.1 Single pair cable:

Conductors:	2-No.16 stranded and twisted on 2-in lay
Insulation:	PVC with 300 Volt, 105 degree C rating
Shield:	100 percent Mylar tape with drain wire
Jacket:	PVC with UL 13, UL 1581, and manufacturers identification
Max overall diameter:	0.262 inch
Miscellaneous:	UL listed for underground wet location use

2.1.2.2 Three conductor (triad) cable:

Conductors:	3-No.16 stranded and twisted on 2-in lay
Insulation:	PVC with 300 Volt, 105 degree C rating
Shield:	100 percent Mylar tape with drain wire
Jacket:	PVC with UL 13, UL 1581, and manufacturers identification
Max overall diameter:	0.276 inch
Miscellaneous:	UL listed for underground wet location use

2.1.2.3 Multiple pair cable:

Conductors:	Multiple 2-No.22 stranded and twisted on 2-in lay
Insulation:	PVC with 300 Volt, 105 degree C rating
Shield:	Individual pairs shielded with 100 percent Mylar tape with drain wire
Jacket:	PVC with UL 13, UL 1581, and manufacturers identification
Max overall diameter:	0.262 inch
Miscellaneous:	UL listed for underground wet location use

2.1.3 Aluminum Conductors

Aluminum conductors shall not be used.

2.1.4 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, or THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.1.5 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.1.6 Service Entrance Cables

Service entrance (SE) and underground service entrance (USE) cables, UL 854.

2.1.7 Non-metallic Sheathed Cable

Non-metallic sheathed cable shall not be used.

2.1.8 Metal-Clad Cable

Metal-clad cable shall not be used.

2.1.9 Armored Cable

Armored cable shall not be used.

2.1.10 Mineral-Insulated, Metal-Sheathed Cable

Mineral insulated cable shall not be used.

2.1.11 Flat Conductor Cable

Flat conductor cable shall not be used.

2.1.12 Tray Cable or Power Limited Tray Cable

UL listed; Type TC or PLTC.

2.1.13 Cord Sets and Power-Supply Cords

Cord sets and power supply cords shall conform to UL 817.

2.2 TRANSIENT VOLTAGE SURGE PROTECTION

Transient voltage surge suppressors shall be provided as indicated. Surge suppressors shall meet the requirements of IEEE C62.41 and be UL listed and labeled as having been tested in accordance with UL 1449. Fuses shall not be used as surge suppression.

2.3 BATTERY CHARGERS

Battery chargers shall be general purpose, continuous current output, with solid state rectifiers. Means shall be provided to regulate and to adjust the dc output voltage. Chargers shall have continuous current ratings of 10 to 15 percent higher than battery current outputs based upon an 8-hour discharge. Battery chargers shall conform to NEMA PE 5.

2.4 CIRCUIT BREAKERS

2.4.1 Molded-Case Circuit Breakers

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489 and UL 877 for circuit breakers and circuit breaker enclosures located in hazardous (classified) locations. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

2.4.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.4.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.4.1.3 Cascade System Ratings

Circuit breakers used in series combinations shall be in accordance with UL 489. Equipment, such as switchboards and panelboards, which house series-connected circuit breakers shall be clearly marked accordingly. Series combinations shall be listed in the UL Recognized Component Directory under "Circuit Breakers-Series Connected."

2.4.1.4 Thermal-Magnetic Trip Elements

Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.

2.4.2 Solid-State Trip Elements

All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure that provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-state sensing shall measure true RMS current with error less than 1 percent on systems with distortions through the 13th harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be of toroidal construction, encased in a plastic housing filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as required

2.4.3 SWD Circuit Breakers

Circuit breakers rated 20 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.4.4 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as required.

2.5 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors shall conform to UL 508 and shall be provided as shown. Protectors shall be used only as part of a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

2.5.1 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall have 100 percent one-way interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

2.5.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

Controller Size	MSCP Designation
NEMA 0	A-N
NEMA 1	A-P
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

2.6 CONDUIT AND TUBING

2.6.1 Flexible Conduit, Steel

General-purpose type flexible steel conduit shall be in accordance with UL 1 and liquid tight flexible conduit steel shall be in accordance with UL 360, and UL 1660.

2.6.2 Rigid Metal Conduit

Rigid metal conduit shall be rigid steel. Material shall be hot dipped galvanized and conform to UL 6. Rigid aluminum conduit shall be 6063 alloy.

2.7 CONDUIT AND DEVICE BOXES AND FITTINGS

2.7.1 Boxes, Metallic Outlet

Metallic outlet boxes shall be in accordance with NEMA OS 1 and UL 514C.

2.7.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

Outlet nonmetallic boxes, flush-device boxes, and covers shall be in accordance with NEMA OS 2 and UL 514C.

2.7.3 Boxes, Outlet for Use in Hazardous (Classified) Locations

Outlet boxes for use in hazardous (classified) location shall be in accordance with UL 886.

2.7.4 Boxes, Switch (Enclosed), Surface-Mounted

Surface -mounted switch enclosed boxes shall be in accordance with UL 98.

2.7.5 Fittings for Conduit and Outlet Boxes:

Fittings for conduit and outlet boxes shall be in accordance with UL 514B.

2.7.6 Fittings for Use in Hazardous (Classified) Locations

Fittings for used in hazardous (classified) locations shall be in accordance with UL 886.

2.7.7 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

PVC Fittings for use with rigid PVC conduit and tubing shall be in accordance with UL 514B.

2.8 CONNECTORS, WIRE PRESSURE

2.8.1 For Use With Copper Conductors

Wire pressure connectors shall be in accordance with UL 486A.

2.9 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

All electrical equipment grounding and bonding shall be in accordance with UL 467.

2.9.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 5/8 inch in diameter by 10 feet in length of the sectional type driven full length into the earth.

2.9.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.10 ENCLOSURES

Enclosures shall be NEMA ICS 6 unless otherwise specified.

2.10.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.10.2 Circuit Breaker Enclosures

Circuit breaker enclosure shall be in accordance with UL 489.

2.10.3 Circuit Breaker Enclosures for Use in Hazardous (Classified) Locations

Circuit breaker enclosure for use in hazardous locations shall be in accordance with UL 877.

2.11 FIXTURES, LIGHTING AND FIXTURE ACCESSORIES/COMPONENTS

Fixtures, accessories and components, including ballasts, lampholders, lamps, starters, and starter holders, shall conform to industry standards specified below.

2.11.1 Fixture, Auxiliary or Emergency

Auxiliary or emergency fixtures shall be in accordance with UL 924.

2.11.2 Fluorescent

2.11.2.1 Fixtures

Fixtures shall be in accordance with NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1570. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles.

2.11.2.2 Electronic Ballasts

Electronic ballasts shall consist of a rectifier, high frequency inverter, and power control and regulation circuitry. The ballasts shall be UL listed, Class P, with a Class A sound rating and shall contain no PCBs. Ballasts shall meet 47 CFR 18 for electromagnetic interference and shall not interfere with the operation of other electrical equipment. Design shall withstand line transients per IEEE C62.41, Category A. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture, using one, two, three, or four lamp ballasts. A single ballast may be used to serve multiple fixtures if they are continuous mounted, factory manufactured for that installation with an integral wireway, and are identically controlled.

2.11.2.2.1 Light output regulation shall be +/- 10 percent.

2.11.2.2.2 Voltage input regulation shall be +/- 10 percent.

2.11.2.2.3 Lamp current crest factor shall be no more than 1.6.

2.11.2.2.4 Ballast factor shall be not less than 85 percent nor more than 100 percent, unless otherwise indicated.

2.11.2.2.5 A 60 Hz filter shall be provided. Flicker shall be no more than 10 percent with any lamp suitable for the ballast.

2.11.2.2.6 Ballast case temperature shall not exceed 25 degree Celsius rise above 40 degree Celsius ambient, when tested in accordance with UL 935.

2.11.2.2.7 Total harmonic distortion shall be in the range of 10-20%.

2.11.2.2.8 Power factor shall not be less than 0.95.

2.11.2.2.9 Ballasts shall operate at a frequency of 20 kHz or more.

2.11.2.2.10 Operating filament voltage shall be 2.5 to 4.5 volts.

2.11.2.2.11 Ballast Efficacy Factor (BEF) shall be in accordance with the following table. Ballasts and lamps shall be matching rapid start or instant start as indicated on the following table. If 32W-F32-T8 lamps and ballasts are used, they must be either all rapid start or all instant start.

Electronic Fluorescent Ballast Efficacy Factors*

Lamp Type	Type Of Starter & Lamp	Nominal Operational Input Voltage	Number of Lamps	Min. Ballast Efficacy Factor
32W F32 T8	rapid or instant start	120 or 277 V	1	2.4
			2	1.4
			3	1.0
			4	0.8

*For ballasts not specifically designed for use with dimming controls

The BEF is calculated using the formula:

BEF = Ballast Factor (in percent) / Power Input

Where Power Input = Total Wattage of Combined Lamps and Ballasts.

2.11.2.2.12 Lamp Holders, Starters, and Starter Holders

Lamp Holders, starters, and starter holders shall be in accordance with UL 542.

2.11.3 High-Intensity-Discharge

2.11.3.1 Fixture

Fixture shall be in accordance with NEMA LE 4 for ceiling compatibility of recessed fixtures and UL 1572.

2.11.3.2 Ballasts

Ballasts shall be in accordance with ANSI C82.4 for multiple supply types and UL 1029.

2.12 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.12.1 Fuses, Low Voltage Cartridge Type shall be in accordance with NEMA FU 1.

2.12.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

2.12.3 Fuses, Class G, J, L and CC shall be in accordance with UL 198C.

2.12.4 Fuses, Class K, High-Interrupting-Capacity Type shall be in accordance with UL 198D.

2.12.5 Fuses, Class H shall be in accordance with UL 198B.

2.12.6 Fuses, Class R shall be in accordance with UL 198E.

2.12.7 Fuses, Class T shall be in accordance with UL 198H.

2.12.8 Fuses for Supplementary Overcurrent Protection shall be in accordance with UL 198G.

2.12.9 Fuses, D-C for Industrial Use shall be in accordance with UL 198L.

2.12.10 Fuseholders shall be in accordance with UL 512.

2.13 INSTRUMENTS, ELECTRICAL INDICATING

All electrical indicating instruments shall be in accordance with ANSI C39.1.

2.14 ARC FLASH PROTECTION

All electrical equipment provided shall be in accordance with NFPA 70E.

2.15 MOTOR CONTROLS

2.15.1 General

Motor controls shall be in accordance with NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

2.15.2 Motor Starters

Combination starters shall be provided with circuit breakers.

2.15.2.1 Reduced-Voltage Starters

Reduced-voltage starters shall be provided for polyphase motors 150 hp or larger. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starter or part winding increment starter having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

2.15.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.15.4 Low-Voltage Motor Overload Relays

2.15.4.1 General

Thermal overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70.

2.15.4.2 Construction

Manual reset type thermal relay shall be melting alloy construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.15.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

2.15.5 Automatic Control Devices

2.15.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

2.15.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.15.5.3 Manual/Automatic Selection

2.15.5.3.1 Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.

2.15.5.3.2 Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.

2.15.5.3.3 Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. All controls shall be 120 volts or less unless otherwise indicated.

2.16 PANELBOARDS

All panelboards shall be rated for the intended voltage. Panelboards shall be dead-front construction and conform to NEMA PB 1 and UL 67.

2.16.1 Circuit breaker panelboards shall be fully rated for the specified circuit breaker fault current interrupting capacity. Series connected short circuit ratings will not be acceptable.

2.16.2 Bus bars for the mains shall be copper. Full size neutral bars shall be included. Phase bussing shall be full height without reduction. Cross connectors shall be copper.

2.16.3 Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

2.16.4 Spaces for future circuit breakers shall be bused for the maximum device that can be fitted into them.

2.16.5 Equipment ground bars shall be furnished.

2.17 RECEPTACLES

2.17.1 Heavy Duty Grade

Heavy duty grade receptacles shall in accordance with NEMA WD 1. Devices shall conform to all requirements for heavy duty receptacles.

2.17.2 Ground Fault Interrupters shall be in accordance with UL 943, Class A or B.

2.17.3 NEMA Standard Receptacle Configurations shall be in accordance with NEMA WD .

2.17.3.1 Single and Duplex, 15-Ampere and 20-Ampere, 125 Volt

15-ampere, non-locking shall be in accordance with NEMA type 5-15R and locking shall be in accordance with NEMA type L5-15R. 20-ampere, non-locking shall be in accordance with NEMA type 5-20R and locking shall be in accordance with NEMA type L5-20R.

2.17.3.2 15-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking shall be in accordance with NEMA type 6-15R and locking shall be in accordance with NEMA type L6-15R. Three-pole, 4-wire grounding, non-locking shall be in accordance with NEMA type 15-15R and locking shall be in accordance with NEMA type L15-15R.

2.17.3.3 20-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking shall be in accordance with NEMA type 6-20R and locking shall be in accordance with NEMA type L6-20R. Three-pole, 4-wire grounding, non-locking shall be in accordance with NEMA type 15-20R and locking shall be in accordance with NEMA type L15-20R.

2.17.3.4 30-Ampere, 125/250 Volt

Three-pole, 3-wire, non-locking shall be in accordance with NEMA type 10-30R and locking shall be in accordance with NEMA type L10-30R. Three-pole, 4-wire grounding, non-locking shall be in accordance with NEMA type 14-30R and locking shall be in accordance with NEMA type L14-30R.

2.17.3.5 30-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking shall be in accordance with NEMA type 6-30R and locking shall be in accordance with NEMA type L6-30R. Three-pole, 4-wire grounding, non-locking shall be in accordance with NEMA type 15-30R and locking shall be in accordance with NEMA type L15-30R.

2.17.3.6 50-Ampere, 125/250 Volt

Three-pole, 3-wire shall be in accordance with NEMA type 10-50R. Three-pole, 4-wire grounding shall be in accordance with NEMA type 14-50R.

2.17.3.7 50-Ampere, 250 Volt

Two-pole, 3-wire grounding shall be in accordance with NEMA type 6-50R. Three-pole, 4-wire grounding shall be in accordance with NEMA type 15-50R.

2.18 SERVICE ENTRANCE EQUIPMENT

Service entrance equipment shall be in accordance with UL 869A.

2.19 SPLICE, CONDUCTOR

Conductor splice shall be in accordance with UL 486C.

2.20 SNAP SWITCHES

Snap switches shall be in accordance with UL 20.

2.21 TAPES

2.21.1 Plastic Tape shall be in accordance with UL 510.

2.21.2 Rubber Tape shall be in accordance with UL 510.

2.22 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with delta-wye windings. "T" connections may be used for transformers rated 15 kVA or below.

2.22.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature rise not exceeding 150 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.
2.22.1.1 600 Volt or Less Primary:

Transformer primaries rated at 600 Volt or less shall be in accordance with NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 1 enclosure.

2.22.2 Average Sound Level

The average sound level in decibels (dB) of transformers shall not exceed the following dB level at 12 inches for the applicable kVA rating range listed unless otherwise indicated:

kVA Range	dB Sound Level
1-51	50
51-150	55
151-300	58
301-500	60
501-700	62
701-1000	64
1001-1500	65
1501 & above	70

2.23 WIRING DEVICES

Wiring devices shall be in accordance with NEMA WD 1, and NEMA WD 6 shall be followed for dimensional requirements of wiring devices.

2.24 NAMEPLATES

2.24.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with white outer layers and a black core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved non-adhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch High Letters	Minimum 1/8 inch High Letters
Panelboards	Control Power Transformers
Starters	Control Devices
Safety Switches	Instrument Transformers
Motor Control Centers	
Transformers	
Equipment Enclosures	
Switchgear	
Switchboards	
Motors	

2.24.2 Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the Contract Drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 12 feet on centers, or if sectional type rods are used, additional sections may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Engineer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.1.2 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When boxes for receptacles, switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the Contract Drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified. Wire fill in conduits located in Class I or II hazardous areas shall be limited to 25 percent of the cross sectional area of the conduit.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as required. Conduit sizes shall be based on use of copper conductors with insulation types as described in Paragraph 3.2 – Wiring Methods. Minimum size of raceways shall be 3/4 inch. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Where conduits or tubing penetrate above grade floor slabs, time-rated partitions or fire walls a fire seal shall be provided. Fire seals shall provide "F" and "T" fire resistance ratings in accordance with UL 1479, except that T ratings are not required for penetrations smaller than or equal to a 4-inch nominal pipe or 16 square inches in overall cross sectional area. Fire resistance ratings shall be the following:

Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = 1 hour, T Rating = 1 hour.

Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding. Wiring installed in underfloor raceway system shall be suitable for installation in wet locations.

3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system using Schedule 80 PVC. Conduit passing vertically through slabs-on-grade shall be rigid steel.

3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Engineer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.6 Supports

Except where otherwise permitted by NFPA 70, conduits and tubing shall be securely and rigidly fastened in place at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means will not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings.

3.2.2 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.2.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.2.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used.

3.2.2.3 Cable Systems

Cable systems shall not be used.

3.2.2.4 Mineral-Insulated Cable

Mineral-insulated systems shall not be used.

3.2.2.5 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

3.2.2.5.1 Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

3.2.2.6 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

3.2.2.6.1 Color-coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for three-phase and single-phase low voltage systems shall be as follows:

3.2.2.6.1.1 277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).

3.2.2.6.1.2 120/240-volt, 1-phase: Black and red.

3.2.2.6.2 Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Engineer.

3.2.2.6.3 Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and must not exceed the maximum specified for that box in UL-03. Only boxes listed in UL-03 shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways, 4 by 4 inch nominal size and smaller, shall be of the cast-metal hub type when located in normally wet locations, when flush and surface mounted on outside of exterior surfaces, or when located in hazardous areas. Cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Large size boxes shall be NEMA 1 or NEMA 3R in wet locations.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to unistrut with the appropriate fasteners, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets that depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of satin finish corrosion resistant steel. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.5 RECEPTACLES

3.5.1 Single and Duplex, 15 or 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and for all receptacles installed in process areas.

3.5.2 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations," "Wet Locations," "Wet Location Only When Cover Closed." Assemblies shall be installed in accordance with the manufacturer's recommendations.

3.5.2.1 Damp Locations

Receptacles installed inside the process building shall be rated for damp locations. They shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

3.5.2.2 Wet Locations

Receptacles installed outside the process building shall be rated for wet locations. They shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use.

3.5.3 Receptacles, single, 20-ampere, 250-volt, shall be ivory molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with appropriate mating cord-grip plug.

3.5.4 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 120-volt for use on alternating current only.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the enclosed molded-case circuit breaker type with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.8 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination. Time-delay and non-time-delay options shall be as required by the equipment manufacturer.

3.8.1 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds.

3.8.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK1 shall have tested interrupting capacity not less than 200,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.8.3 Continuous Current Ratings (600 Amperes and Smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class RK1, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.8.4 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.9 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 5 feet beyond the building wall and 2 feet below finished grade, for interface with the exterior service lateral conduits. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of SECTION 16375 - ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.10 BATTERY CHARGERS

Battery chargers shall be installed in conformance with NFPA 70.

3.11 EQUIPMENT CONNECTIONS

All wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of Paragraph 3.2 - Wiring Methods. Liquid-tight flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors.

3.11.1 Motors and Motor Control

Motors, and motor controls shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.12 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.13 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Government.

3.14 FIELD TESTING

Field testing shall be performed in the presence of the Engineer. The Contractor shall notify the Engineer seven days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Engineer. The Contractor shall maintain a written record of all tests that includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.14.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment that are damaged due to improper test procedures or handling.

3.14.2 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Standard 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

3.14.2.1 Single rod electrode - 10 ohms.

3.14.2.2 Grid electrode - 10 ohms.

3.14.3 Ground-Grid Connection Inspection

All below-grade ground-grid connections will be visually inspected by the Engineer before backfilling. The Contractor shall notify the Engineer 24 hours before the site is ready for inspection.

3.14.4 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.14.4.1 Low Voltage Cable Tests

3.14.4.1.1 Continuity test.

3.14.4.1.2 Insulation resistance test.

3.14.5 Motor Tests

3.14.5.1 Phase rotation test to ensure proper directions.

3.14.5.2 Operation and sequence of reduced voltage starters.

3.14.5.3 High potential test on each winding to ground.

3.14.5.4 Insulation resistance of each winding to ground.

3.14.5.5 Vibration test.

3.14.5.6 Dielectric absorption test on motor and starter.

3.14.6 Dry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers 10 kVA and above:

3.14.6.1 Insulation resistance test phase-to-ground, each phase.

3.14.6.2 Turns ratio test.

3.14.7 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers:

3.14.7.1 Circuit Breakers, Low Voltage

3.14.7.1.1 Insulation resistance test phase-to-phase, all combinations.

3.14.7.1.2 Insulation resistance test phase-to-ground, each phase.

3.14.7.1.3 Closed breaker contact resistance test.

3.14.7.1.4 Manual and electrical operation of the breaker.

3.14.7.2 Circuit Breakers, Molded Case

3.14.7.2.1 Insulation resistance test phase-to-phase, all combinations.

3.14.7.2.2 Insulation resistance test phase-to-ground, each phase.

3.14.7.2.3 Closed breaker contact resistance test.

3.14.7.2.4 Manual operation of the breaker.

3.14.8 Motor Control Centers

3.14.8.1 Insulation resistance test phase-to-phase, all combinations.

3.14.8.2 Insulation resistance test phase-to-ground, each phase.

3.14.8.3 Manual and electrical operational tests.

3.15 OPERATING TESTS

After the installation is completed, and at such time as the Engineer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with Paragraph 1.3.10 – Field Test Reports.

3.16 FIELD SERVICE

3.16.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Engineer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the approved Operation and Maintenance (O&M) Manual. Additionally, the course instructions shall demonstrate all routine maintenance operations. A DVD Format Disc of the entire training shall be submitted.

3.16.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of equipment, assist in the performance of the onsite tests, oversee initial operations, and instruct personnel as to the operational and maintenance features of the equipment.

3.17 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1 GENERAL

1.1 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required and install all panelboards as shown on the Drawings and as specified herein.

1.2 REFERENCES

1.2.1 Panelboards shall be in accordance with the Underwriter Laboratories (UL) "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code (NEC).

1.2.2 Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 Rating

2.1.1.1 Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.

2.1.1.2 Circuit breaker panelboards shall be fully rated for the specified circuit breaker fault current interrupting capacity. Series connected short circuit ratings will not be acceptable.

2.2 MATERIALS (NEMA 1)

2.2.1 Interiors

2.2.1.1 All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.

2.2.1.2 Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.

2.2.1.3 Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

2.2.1.3 A nameplate shall be provided listing manufacturer's name, panel type and rating.

2.2.2 Buses

2.2.2.1 Bus bars for the mains shall be of copper. Full size neutral bars shall be included. Phase bussing shall be full height without reduction. Cross connectors shall be copper.

2.2.2.2 Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

2.2.2.3 Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

2.2.2.4 Equipment ground bars shall be furnished.

2.2.3 Boxes

2.2.3.1 Recessed or flush mounted boxes shall be made from galvanized code gauge steel having multiple knockouts, unless otherwise noted. Boxes shall be of sufficient size to provide a minimum gutter space of 4-in on all sides.

2.2.3.2 Surface mounted boxes and trims shall have an internal and external finish as specified in Paragraph 2.2.4.4 below. Surface mounted boxes shall be field punched for conduit entrances.

2.2.3.3 At least four studs for mounting the panelboard interior shall be furnished.

2.2.4 Trim

2.2.4.1 Hinged doors covering all circuit breaker handles shall be included in all panel trims.

2.2.4.2 Doors shall have semi flush type cylinder lock and catch, except that doors over 48-in in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Furnish two keys for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.

2.2.4.3 The trims shall be fabricated from code gauge sheet steel.

2.2.4.4 All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.

2.2.4.5 Trims for flush panels shall overlap the box by at least 3/4-in all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

2.3 CIRCUIT BREAKERS

2.3.1 Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.

2.3.2 Circuit breakers shall be molded case, bolt-in type.

2.3.3 Each circuit breaker used in 120/208 Volt panelboards shall have an interrupting capacity of not less than 10,000 Amps, RMS symmetrical.

2.3.4 Each circuit breaker used in 480/277 Volt panelboards shall have an interrupting capacity of not less than 22,000 Amps, RMS symmetrical.

2.3.5 Circuit breakers shall be as manufactured by the panelboard manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Mount boxes for surface mounted panelboards so there is at least 1/2-in air space between the box and the wall.

3.1.2 Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses.

3.1.3 Type circuit directories giving location and nature of load served. Install circuit directories in each panelboard.

3.1.4 Install markers on the front cover of all panelboards which identify the voltage rating. Markers shall be made of self sticking B-500 vinyl cloth printed with black characters on an Alert Orange background, 2-1/4-in high by 9-in wide.

3.1.5 Install a 1-in by 3-in laminated plastic nameplate with 1/4-in white letters on a black background on each panelboard. Nameplate lettering shall be as shown on the Drawings. Nameplates shall be stainless steel screw mounted.

END OF SECTION

SECTION 16502

LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Provide a complete lightning protection system for the Old Roosevelt Field Superfund Site. The system shall be UL labeled and shall be designed and installed in compliance with provisions of UL-96A and NFPA-780.

1.1.2 Employ the services of a licensed lightning protection systems engineering company to design and install the lightning protection system and prepare submittals as specified in Paragraph 1.3 herein.

1.1.3 The lightning protection system shall be checked by a UL field inspector upon completion of the installation. Assume full responsibility for the correctness of the installation and shall make any and all corrections and additions deemed necessary by the UL inspector. Pay for all costs of the UL inspection and any subsequent reinspections as required.

1.1.4 The lightning protection system for the building shall consist of an aluminum ground wire with air terminals which shall be grounded to the building structural steel or ground grid at regular intervals. The Contractor has the option of submitting alternate methods of lightning protection for consideration in his/her proposal, provided they offer an equal or greater degree of protection than those specified.

1.1.5 The grounding systems for the building shall be provided under SECTION 16660 - GROUNDING SYSTEM.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

<u>UNDERWRITERS LABORATORIES (UL)</u>

UL 96A	UL Standard for Safety Installation Requirements for Lightning Protection System

<u>NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)</u>

NFPA 780	Lightning Protection Code

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Lighting Protection System; Shop Drawings; EA

The lightning protection systems engineering company shall submit detailed installation drawings.

1.3.2 Lighting Protection System; Design Data; EA

The lightning protection systems engineering company shall submit material specifications.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 All materials shall be new and shall comply in weight, size and composition with the requirements of UL and NFPA.

2.1.2 Grounding materials and methods shall be equal to those specified under SECTION 16660 - GROUNDING SYSTEM.

2.1.3 The following is a brief description of the various items of material:

2.1.3.1 Air Terminals

Air terminals shall be 5/8-in by 18-in minimum solid aluminum and shall extend at least 18-in above the object to be protected. All air terminal bases shall be cast bronze with stainless steel bolt pressure cable connectors. The air terminals should be spaced so as not to exceed 20-ft apart around the outside perimeter of the roof or the ridge and not over 50-ft apart through the center of flat roof areas. The air terminals in the center roof area shall be 5/8-in by 48-in solid aluminum with a proper brace. All air terminal bases for flat roof areas shall be of the adhesive type.

2.1.3.2 Conductors

Conductors shall consist of UL listed 37 strands of 13 gauge aluminum wire weighing 200 lbs per 1000-ft and installed in accordance with the UL Code. Conductors on the flat roof areas may be run exposed. Ground connections shall be made to the main down conductor at a maximum of 60-ft-0-in on centers.

2.1.3.3 Fasteners

Conductor fasteners shall be an approved type of non-corrosive metal, have ample strength to support conductors and shall be spaced not to exceed 3-ft-0-in centers. Masonry type cable fasteners spaced every 3-ft-0-in on masonry. Adhesive type cable fasteners spaced every 3-ft-0-in on flat roofs.

2.1.3.4 Cable Connectors

All cable connectors shall be cast bronze with screw-pressure type stainless steel bolts and nuts.

PART 3 EXECUTION

3. 1 INSTALLATION

3.1.1 All materials shall be installed by experienced workmen that specialize in this type of work. The lightning protection system shall be installed per approved shop drawings and UL and NFPA recommended practices.

3.1.2 The lightning protection system engineering company shall provide job site assistance and supervision of the installation as required, and shall be present during the UL inspection.

3.1.3 The structural steel columns on the outside perimeter of the building may be utilized as the main down conductor from roof to ground for the lightning protection system. No other parts of the structural steel structure will be accepted to substitute for lightning conductors. The steel columns around the outside perimeter of the building shall be grounded at every other column and in no case shall average over 60-ft apart. Where the steel columns are used, a connection to the top of each steel column shall be made through the roof and connected to the roof conductor. A thru the roof connector shall be installed where a conductor penetrates the roof, by the lightning protection contractor. The thru the roof connector will be 1/2-in stainless steel threaded rod equipped with the necessary lead or neoprene washers and stainless nuts for a watertight seal. Also, copper pitch pans shall be furnished under this Section and installed by the roofing contractor.

3.1.4 All concealed conductors shall be installed in Schedule 40 PVC conduit.

3.1.5 All metal bodies within 6-ft of the conductor shall be bonded to the system with approved fittings and conductor. Connections between dissimilar metals shall be made with approved bimetallic connections.

END OF SECTION

SECTION 16600

UNDERGROUND SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish and install a complete underground system of raceways, manholes and handholes.

1.1.2 All underground systems shall be steel reinforced and concrete encased.

1.1.3 The Contractor shall be responsible for setting manholes and handholes at the proper elevation such that the pitch of raceways will be towards manholes and handholes and away from structures, vaults and buildings.

1.1.4 Where referred in this Section, raceways are underground conduits - Ductbanks are a collection of underground raceways. Underground system is the collection of underground raceways, manholes and handholes.

1.1.5 Duct banks shall be steel reinforced and concrete encased up to the building, structure, and handholes.

1.1.5.1 Duct bank and handhole depths vary. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required depths and install raceways, manholes and handholes at that required depth at no additional cost to the Owner.

1.1.5.2 Coordinate with other utilities, yard piping, yard structures and field conditions to determine required paths and depths.

1.2 RELATED WORK

1.2.1 Excavation and backfilling, including gravel and sand bedding, are included in Division 2.

1.2.2 Concrete and reinforcing steel are included in Division 3.

1.2.3 Groundwater control is included in Division 2.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C33	Standard Specification for Concrete Aggregates
ASTM C62	Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)
ASTM C150	Standard Specification for Portland Cement
ASTM C207	Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections

1.4 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.4.1 Shop Drawings; Shop Drawings; EA

The Contractor shall submit shop drawings for the following: handholes, plastic duct spacers, handhole frames and covers, buoyancy calculations, and warning tape.

1.4.2 Product Data; Product Data; EA

The Contractor shall submit product data for the following: handholes, plastic duct spacers, handhole frames and covers, buoyancy calculations, and warning tape.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Raceways shall be polyvinyl chloride conduit encased in steel reinforced concrete, except that rigid steel conduit shall be used for 300 Volt shielded wire, I/O and data highway wiring. Refer to SECTION 16110 - RACEWAYS, BOXES, FITTINGS, AND SUPPORTS for material requirements.

2.1.2 Pulling-in irons and hardware shall be galvanized steel.

2.1.3 Precast manholes and handholes shall be designed as specified below for precast concrete structures. Manufacturer shall provide buoyancy calculations to the Engineer for approval.

2.1.3.1 Provide lifting lugs in each precast section for handling.

2.1.3.2 All sections, flat slab tops and grade rings shall conform to ASTM C478.

2.1.3.3 Base, riser and transition top sections shall have tongue and groove joints.

2.1.3.4 Compressive strength for shipping shall be 4000 psi.

2.1.3.5 Design precast concrete base, riser, transition top, flat slab top and grade ring for a minimum H-20 loading plus earth load. Earth load shall be calculated from the future grade indicated as final grade with a unit weight of 130 pcf.

2.1.3.6 The date of manufacture, name and trademark of manufacturer shall be marked on the inside of each precast section.

2.1.3.7 Provide integrally cast knock-out panels in precast concrete manhole and handhole sections at locations indicated and with sizes indicated. Knock-out panels shall have no steel reinforcing.

2.1.3.8 Seal tongue and groove joints of precast manhole and handhole sections with rubber O-ring gasket. O-ring gasket shall conform to ASTM C443. In lieu of the O-ring gasket, a flexible joint sealant may be used. Completed joints shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

2.1.3.9 Coat outer surfaces of precast manholes and handholes with two coats of dampproofing at the rate of 30 to 60 sq ft per gallon in accordance with manufacturer's instructions.

2.1.4 Handholes shall be precast concrete, heavy-duty type, designed for a Class H-20 wheel load and conform to ASTM C478.

2.1.5 Manhole and handhole frames and covers shall be cast iron, heavy duty type for Class H-20 wheel loading.

2.1.6 Ground rods and other grounding materials and methods shall be as specified in SECTION 16660 - GROUNDING SYSTEM.

2.1.7 Pull line for spare conduits shall be 1/8-in nylon rope.

2.1.8 Detectable Warning Tape

2.1.8.1 Each ductbank section shall be marked by means of a detectable warning tape (tracer tape). The detectable warning tape shall be capable of being detected or located by either conductive or inductive location techniques.

2.1.8.2 The detectable warning tape shall consist of 5 mil (.005-in) overall thickness; five-ply composition; ultra-high molecular weight; virgin polyethylene; acid; alkaline and corrosion resistant; with 150 pounds of tensile break strength minimum per 6-in width.

2.1.8.3 The top side of the tracer tape shall be color banded red for electrical and high voltage lines, and orange for signal, communication, telephone and fire alarm lines. Tracer tape shall be 4-in wide with four color bands. The tape shall be inscribed with the warning message for the utility such as "CAUTION - ELECTRICAL LINED BURIED BELOW".

2.1.9 Bricks for raising manhole and handhole frames to finished grade shall conform to ASTM C62. Mortar shall be composed of one part portland cement, two parts sand and hydrated lime not to exceed 10-lbs to each bag of cement.

2.1.9.1 Portland cement shall be ASTM C150, Type II.

2.1.9.2 Hydrated lime shall conform to ASTM C207.

2.1.9.3 Sand shall be washed, cleaned, screened, well graded with all particles passing a No. 4 sieve and conform to ASTM C33.

2.1.10 Sidewalk boxes and boxes for concrete slabs shall be cast iron intended for outdoor use primarily to provide a degree of protection against falling rain, sleet and external ice formation (NEMA 3R).

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Install raceways to drain away from buildings. Raceways between handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3-in per 100-ft.

3.1.2 Steel reinforce and concrete encase all raceway banks.

3.1.3 Lay raceway lines in trenches on mats of bank gravel not less than 6-in thick and graded as per Paragraph 3.15.

3.1.4 Use plastic spacers located not more than 4-ft apart to hold raceways in place. Spacers shall provide not less than 2-in clearance between raceways and edge of concrete envelope. Power system raceways shall be separated by 7.5-in center-to-center. Non-power system raceways shall be separated by 4.5-in center-to-center.

3.1.5 The minimum cover for raceway banks shall be 24-in unless otherwise permitted by the Engineer.

3.1.6 Make raceway entrances to buildings, and structures with steel conduit not less than 10-ft long. Conduits run below floor slabs in slab-on-grade construction shall be steel.

3.1.7 Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings for steel conduit.

3.1.8 Where bends in raceways are required, use long radius elbows, sweeps and offsets.

3.1.9 Swab all raceways clean before installing cable.

3.1.10 Plug and seal spare raceways watertight at all buildings and structures.

3.1.11 Seal the ends of raceways and make watertight at all buildings and structures.

3.1.12 Train cables in handholes and support and restrain them on racks and hooks. Furnish inserts on all handhole walls for mounting future racks as well as racks required for present installation.

3.1.13 Rigid galvanized steel conduit shall be used for elbows and risers at the utility pole for electrical and telephone service conduits.

3.1.14 Rigid galvanized steel elbows shall be used for pad-mounted transformer stub-ups and all stub-ups through concrete floors, walls and slabs.

3.1.15 A pull line shall be installed and left in all spare raceways.

3.1.16 Install detectable warning tape in all ductbanks. Where trench exceeds 24-in width, provide additional detectable tape runs to mark each side of the ductbank in addition to the one in the center.

3.1.17 Manhole and handhole Installation

3.1.17.1 Place bases on bend of 12-in screened gravel. Set base grade so that a minimum grade adjustment of 4-in of brickwork is required to bring the manhole and handhole frame and cover to final grade.

3.1.17.1.1 Use precast concrete grade rings or brick and non-shrink mortar to adjust frame and cover to final grade.

3.1.17.2 Set precast sections plumb with a 1/4-in maximum out-of-plumb tolerance. Seal joints of precast sections with either a rubber O-ring set in a recess or a flexible joint sealant used in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink grout and finished flush with the adjoining surfaces. Caulk the inside of leaking barrel section joints with lead wool or non-shrink grout. If leaks appear in the handholes the inside joints shall be cleaned out and remade in a manner that will result in a watertight joint.

3.1.17.3 Allow joints to set for 24 hours before backfilling. Backfilling shall be performed by bringing the fill up evenly on all sides.

3.1.17.4 Plug holes in concrete with non-shrink grout or non-shrink grout in combination with concrete plugs. Finish flush on the inside.

3.1.17.5 Cut holes in precast sections to accommodate conduits prior to setting handhole sections in place.

3.1.18 Brickwork

3.1.18.1 Mix mortar only in such quantity as may be required for immediate use and use before initial set takes place. Anti-freeze mixtures shall not be included in the mortar. Install masonry when the outside temperature is above 40 degrees F unless provisions are made to protect the mortar, brick and finished work from frost by heating and enclosing the work with tarpaulins other equivalent material.

3.1.18.2 Set handhole covers and frames in a full mortar bed. Utilize bricks or precast concrete grade rings, a maximum of 8-in thick, to assure frame and cover are set to the finished grade.

3.1.19 Dampproofing

Coat outer surfaces of precast manholes and handholes with two coats of dampproofing at the rate of 30 to 60 sq ft per gallon in accordance with manufacturer's instructions.

3.2 CLEANING

All new manholes and handholes shall be thoroughly cleaned of all silt, debris and foreign matter prior to final inspection.

END OF SECTION

SECTION 16660

GROUNDING SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish all labor, materials, equipment and incidentals required and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code (NEC).

1.1.2 All raceways, conduits, ducts and multi-conductor cables shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.

1.1.3 A supplemental grounding conductor shall be provided from each power panelboard, lighting panelboard, motor or process control panel, to the buried ground grid. Supplemental grounding conductors shall be installed in PVC Schedule 80 conduit. The supplemental grounding conductors for switchgear shall consist of redundant code sized cables in conduit. Conductors shall be connected to opposite ends of the distribution equipment ground bus.

1.1.4 Provide ground mesh/grid in concrete slabs in all buildings at each level.

1.1.5 Provide ground resistance measurements and grounding design calculations for the grounding system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

<u>NATIONAL ELECTRIC CODE (NEC)</u>

Article 250 Grounding and Bonding

<u>UNDERWRITERS LABORATORIES (UL)</u>

UL 467 Standard for Safety Grounding and Bonding Equipment

1.3 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.3.1 Shop Drawings; Shop Drawings; EA

The Contractor shall submit shop drawings for the following: manufacturer's name and catalog data for ground rods, exothermic welding methods, grounding clamps including installation requirements and materials.

1.3.2 Product Data; Product Data; EA

The Contractor shall submit product data for the following: manufacturer's name and catalog data for ground rods, exothermic welding methods, grounding clamps including installation requirements and materials.

1.3.3 Test Results; Test Reports; EA

The Contractor shall submit test results of grounding and bonding resistance testing as specified herein.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Conduit shall be as specified under SECTION 16110 - RACEWAYS, BOXES, FITTINGS, AND SUPPORTS.

2.1.2 Wire shall be as specified under SECTION 16000 - ELECTRICAL - GENERAL PROVISIONS.

2.1.3 Ground rods shall be 3/4-in by 10-ft copper clad steel and constructed in accordance with UL 467. The minimum copper thickness shall be 0.25 mm.

2.1.4 Grounding conduit hubs shall be malleable iron type, and of the correct size for the conduit.

2.1.5 Water pipe ground clamps shall be cast bronze saddle type, and of the correct size for the pipe.

2.1.6 Buried grounding connections shall be by Cadweld process, or equal exothermic welding system.

2.1.6.1 Molds, cartridge materials and accessories shall be provided in kit form and selected per the manufacturer's written instructions for specific types, sizes and combinations of conductors and connected items. Molds and powder shall be furnished by the same manufacturer.

2.1.7 Ground Rod Test Wells

Ground rod test wells shall be complete with cast iron riser ring and traffic cover marked "GROUND ROD". Boxes and covers shall be suitable for H-20 wheel loading.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Run grounding electrode conductors in rigid steel conduits. Bond the protecting conduits to the grounding electrode conductors at both ends. Do not allow water pipe connections to be painted. If the connections are painted, disassemble them and re-make them with new fittings.

3.1.2 Install equipment grounding conductors with all feeders and branch circuits.

3.1.3 Bond all steel building columns in new structures together with ground wire in rigid conduit and connect to the distribution equipment ground bus.

3.1.4 Ground wire connections to structural steel columns shall be made with exothermic welds.

3.1.5 Metal conduits stubbed into a motor control center or floor mounted electrical enclosure shall be terminated with insulated grounding bushings and connected to the motor control center or electrical enclosure ground bus. Bond boxes mounted below motor control centers to the motor control center ground bus. Size the grounding wire in accordance with NEC Table 250-122, except that a minimum No. 12 AWG shall be used.

3.1.6 Liquid tight flexible metal conduit in sizes 1-1/2-in and larger shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps.

3.1.7 Ground transformer neutrals to the nearest available grounding electrode with a conductor sized in accordance with NEC Article 250-66.

3.1.8 All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded and bonded in accordance with the NEC.

3.1.9 Seal exposed connections between different metals with No-Oxide Paint Grade A or equal.

3.1.10 Lay all underground grounding conductors slack and, where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified herein.

3.1.11 Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

3.1.12 All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 THW green conductor connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw.

3.1.13 Molds used for welding shall be new. The number of welds made per mold shall not exceed manufacturer's recommendations

3.1.14 Ground metal poles supporting outdoor lighting fixtures to a supplemental grounding electrode (rod) in addition to the separate equipment grounding conductor run with the supply branch circuit.

3.1.15 Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with ground clamp connectors.

3.1.16 Bond interior mental piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters and HVAC equipment. Use braided-type bonding straps.

3.1.17 Bond the steel reinforcing located in the basement floor slab to the building ground loop. Make a minimum of 6 connections using 2/0 AWG copper conductor.

3.1.18 Install driven ground rods in manholes and handholes close to wall and set rod depth so 4-in will extend above finished floor. Protect ground rods with double wrapping of pressure-sensitive tape or heat shrunk insulating sleeve from 2-in above to 6-in below concrete floor. Seal floor opening with waterproof, non-shrink grout. Where ground rods are installed outside of manhole or handhole, provide a No. 4/0 AWG bare, tinned copper conductor from ground rod into manhole or handhole through a waterproof sleeve in the wall.

3.2 INSPECTION AND TESTING

3.2.1 Inspect the grounding and bonding system conductors and connections for tightness and proper installation.

3.2.2 Use Biddle Direct Reading Earth Resistance Tester or equivalent test instrument to measure resistance to ground of the system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

3.2.3 All test equipment shall be provided under this Section and approved by the Engineer.

3.2.4 Resistance to ground testing shall be performed during dry season. Submit test results in the form of a graph showing the number of points measured (12 minimum) and the numerical resistance to ground.

3.2.5 Testing shall be performed before energizing the distribution system.

3.2.6 A separate test shall be conducted for each building or system.

3.2.7 Test all grounded cases and metal parts associated with the electrical equipment for continuity with the ground system.

3.2.8 Submit test results to the Engineer for review.

3.2.9 Notify the Engineer immediately if the resistance to ground for any building or system is greater than five ohms.

END OF SECTION

SECTION 16742

HIGH SPEED BROADBAND SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, materials, equipment and incidentals required for the installation of a high speed broadband system including coaxial cables, connecting equipment, cable modem, connecting hardware to transport the high speed signals throughout the premises to user locations as indicated. The system shall include the necessary router and firewall as required for a secure system.

1.1.2 The equipment used and the firewall security system used shall be as approved by the Engineer.

1.1.3 Underground ducts shall be pipe conduit or encased in concrete. Trenching shall be performed in accordance with SECTION 02300 - EARTHWORK.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of the standards below, the revision in effect at the time of contract award shall apply.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

INTERNATIONAL TELECOMMUNICATION UNION (ITU)

ITU H.222.0 AMD 1	Information Technology Genetic Coding of Moving Pictures and Associated Audio Information
ITU V.44	Pre-published Data Compression Procedures
ITU V.92	Enhancements to Recommendation V.90 Series: V, with Amendments 1 and 2

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15 Radio Frequency Devices

1.3 FEES

The Contractor shall make all necessary arrangements with High Speed Cable TV Service Provider Company for any participation that may be necessary and furnish all labor and material that may be required and pay all charges the service provider companies may have for their service.

1.4 SUBMITTALS

Engineer approval is required for submittals with a "EA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

1.4.1 Shop Drawings; Shop Drawings; EA

1.4.1.1 High Speed Cable Broadband System

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment details, outlet face plate details for each outlet configuration, and descriptions and types of cables, conduits, and cable trays, if used. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

1.4.1.2 Installation

Record drawings for the installed Cable Broadband System. The drawings shall show the locations of cable terminations, including outlets, and location and routing of cables. The identifier for each termination and cable shall appear on the drawings.

1.4.1.3 Shop Drawing Instructions

The Contractor shall check shop drawings for accuracy and contract requirements prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to the specifications and the approved drawings. This statement shall also list all exceptions to the specifications and the approved drawings. Shop drawings not checked and noted shall be returned.

1.4.2 Spare Parts; Product Data; EA

Lists of spare parts, tools, and test equipment, as specified.

1.4.3 Manufacturer's Recommendations; Manufacturer's Instructions; EA

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be provided prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received and approved by the Engineer.

1.4.4 Test Plan; Test Reports; EA

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before testing begins. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

1.4.5 Qualifications; Pre-Construction Submittals; EA

Proof of the qualifications of the Contractor, Installers, and Manufacturers that will perform the work, and provide the specified products.

1.4.6 Test Reports; Test Reports; FIO

Test reports in booklet form with witness signatures verifying execution of tests shall be provided. The cable system testing documentation shall include the physical routing and a test report for each cable (end-to-end) from the installed outlet to the main termination point. Test reports shall be submitted within 7 days after completion of testing.

1.4.7 Materials and Equipment; Certificates; FIO

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements must be submitted. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, is acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

1.4.8 Operation and Maintenance Data; O&M Data; FIO

The Contractor shall submit operations and maintenance data under SECTION 01850 - FACILITY SYSTEM OPERATIONS AND MAINTENANCE MANUAL AND STARTUP TRAINING.

1.5 SYSTEM DESCRIPTION

1.5.1 The high speed cable broadband system shall consist of coaxial cables, modem, router and connecting hardware to route the Ethernet cables throughout the building to user locations as indicated. The system design shall provide adequate communications pathways and spaces using EIA ANSI/TIA/EIA-569 as a requirement. Coordinate all electrical, grounding, and HVAC equipment location requirements with the associated disciplines. Cable distribution configuration must be coordinated with the user's representative, if known. For typical applications, there will normally be one cable outlet provided for each control system interface. The same cable pathways and spaces normally used for both telephone and data networks are acceptable for the cable broadband distribution systems, provided that sufficient additional space allowance is provided.

1.5.2 Hardware for protecting or connecting the main cable broadband system to sources of outside services entering the facility should be furnished and installed by the local cable broadband provider. The designer shall allow for adequate space, power, and cooling accommodating the cable broadband provider's equipment.

1.6 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C and in the range of 0 to 95 percent relative humidity, non-condensing.

1.7 QUALIFICATIONS

1.7.1 Minimum Contractor Qualifications

Work under this section shall be performed, and equipment shall be furnished and installed, by a qualified Contractor as defined herein. The Contractor shall have a minimum of two years of experience in the installation and testing of coaxial cable-based high speed internet cable broadband systems and equipment. Installers assigned to the installation of this system or its components shall have a minimum of two years of experience in the installation of the specified coaxial cable and components.

1.7.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract shall be products of manufacturers that have a minimum of two years of experience in producing the types of systems and equipment specified.

1.8 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

1.9 SPARE PARTS

The Contractor shall submit spare parts data for each different item of material and equipment specified, after approval of detail drawings, not later than 2 months prior to the date of start-up. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least one year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

2.1.2 Conduit and outlet boxes shall be as specified under SECTION 16402 - ELECTRICAL WORK, INTERIOR.

2.1.3 Underground materials shall be as specified under SECTION 16375 - ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. The Contractor can propose the use of direct burial rigid galvanized conduit without concrete encasement in certain applications where applicable. The Engineer will make the final determination if the use of rigid steel conduit for underground use is suitable for the application.

2.1.4 Terminal cabinets shall be similar in construction to panel board cabinets furnished under SECTION 16402 – ELECTRICAL WORK, INTERIOR except that they shall have 5/8-inch plywood backboards that have two coats of wood sealer. Cabinet sizes shall be as required by Telephone Company.

2.1.5 Raceways shall be rigid steel conduit as shown on the Contract Drawings.

2.1.6 Coaxial Cable

Coaxial cable shall be RG-6/U, quad shield. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals identifying cable type. Cable shall be rated CMP per NFPA 70. Interconnecting cables shall be cable assemblies consisting of RG-6/U coaxial cable with male connectors at each end, provided in lengths determined by equipment locations as shown.

2.1.7 Outlets

Cable television outlets, including wall outlet plates, shall be equipped with a female connector to accept the connecting coaxial cable from the high speed cable modem. Faceplates provided shall be impact resistant plastic.

2.1.8 Outlets Boxes

Electrical boxes for cable television outlets shall be 4-11/16 inch square by 2-1/8 inches deep with minimum 3/8 inch deep single or two gang plaster ring as shown. Conduits shall be minimum 1 inch.

2.1.9 Cable Modem

2.1.9.1 The intended service will allow IP traffic to achieve transparent bi-directional transfer between the Cable Modem Termination System—Network Side Interface (CMTS-NSI) and the Cable Modem to Customer Premises Equipment (CPE Interface). The cable modem shall support LAN segments and employ the Spanning Tree Algorithm and Protocol per ANSI/IEEE Std. 802.1D. The modem shall support a PC computer hardware or network server.

2.1.9.2 The cable modem shall be provided with an Ethernet 100BASE-T network interface. The modem shall include Universal Serial Bus (USB) Communications Software supporting TCP/IP stack software capable of supporting DHCP/BOOTP, SNAP addressing, and multicast.

The modem shall be capable of Data Transfer Rates of 54 Mbps. The modem shall meet the following requirements:

2.1.9.2.1 Modem protocols & specifications: DOCSIS 1.1, DOCSIS 2.0

2.1.9.2.2 Modem interface type USB / Ethernet Line coding format QPSK, 8 QAM, 16 QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM

2.1.9.2.3 Modem enclosure type: External

2.1.9.2.4 Expansion / Connectivity Port(s) Total (Free) / Connector Type 1 TV antenna Ethernet 10Base-T/100Base-TX: F connector, 1 Network RJ-45, 1 USB 4 pin USB Type B.

2.1.9.2.5 Power Supply / Device Power adapter: External AC 120V single phase

2.1.10 Power Line Surge Protection

2.1.10.1 All equipment connected to AC circuits shall be protected from power line surges. Equipment shall withstand surge test waveforms described in IEEE C62.41. Surge protection devices shall be selected based on voltages and current ratings of components to be protected. Fuses shall not be used for surge protection.

2.1.10.2 The system designer will determine if any additional inputs or outputs require surge protection and show the requirement for them on the drawings, or in a schedule as required.

2.1.11 Communications Circuit Surge Protection

2.1.11.1 All communications equipment shall be protected against surges induced on any communications circuit. All cables and conductors which serve as communications circuit between the local processor and the central processor shall have surge protection devices installed at each end. Protection shall be provided at the equipment and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 3 feet of the building cable entrance. Surge protection devices shall be selected based on voltages and current ratings of components to be protected. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

2.1.11.1.1 A waveform with a 10 microsecond rise time, a 1000 microsecond width, a peak voltage of 1500 volts and a peak current of 60 amperes.

2.1.11.1.2 A waveform with an 8 microsecond rise time, a 20 microsecond waveform, a peak voltage of 1000 volts and a peak current of 500 amperes

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 System components and appurtenances shall be installed in accordance with

NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete cable system, ready to connect to router signal sources, shall be provided.

3.1.2 Conduits, outlets, raceways, and wiring shall be installed in accordance with SECTION 16402 - ELECTRICAL WORK, INTERIOR.

3.1.3 Cables and outlets shall be individually labeled and marked. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

3.1.4 Horizontal Cable Installation

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Cable not in a wireway shall be suspended a minimum of 8 inches below ceilings by cable supports no greater than 60 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided. Cables shall be terminated unless shown otherwise. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. In raised floor areas, cable shall be installed after the flooring system has been installed. Cable 6 feet long shall be neatly coiled not less than 12 inches in diameter below each feed point in raised floor areas.

3.1.5 Riser Cable Installation

The rated cable pulling tension shall not be exceeded. Riser cable support intervals shall be in accordance with manufacturer's recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

3.1.6 Outlets

3.1.7.1 Faceplates

Each faceplate shall be labeled with its function and a unique number to identify the cable run.

3.1.7.2 Cables

Cables shall have a minimum of 6 inches of slack cable loosely coiled into the cable television outlet boxes. Minimum manufacturer's bend radius shall not be exceeded.

3.1.7.3 Pull Cords

Pull cords shall be installed in conduits serving the cable broadband system which does not initially have cable installed.

3.2 The system shall be a completely high speed communication system, capable of providing all the functionality and required functions required by the process control system.

END OF SECTION